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FOREST RESEARCH IN THE CALIFORNIA REGION

1930 - 1931

REPORT OF REGION 5

INVESTIGATIVE COMMITTEE MEETING

March 2 to 4, 1931

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REPORT OF REGION 5 INVESTIGATIVE COMMITTEE MEETING

March 2 to 4, 1931

S. B. Show, Chairman - C. L. Hill, Secretary

The Regional Investigative Committee is composed of representatives of all agencies engaged in forest research or investigative work in the California Region. It meets annually under the chairmanship of the U. S. Regional Forester at as early a date after the beginning of the calendar year as possible. It considers the reports of work accomplished and the plans for future work presented by the respective agencies and endeavors to promote the effectiveness of forest research work through the opportunity of mutual counsel and suggestions, especially in the direction of coordination and cooperation between workers in the same and allied fields.

Attendance 1931

U. S. Forest Service

California Regional Office

S. B. Show	Regional Forester
T. D. Woodbury) C. E. Dunston)	Forest Management
R. L. Deering) P. P. Pitchlynn)	Operation
W. I. Hutchinson) R. W. Ayres)	Public Relations
L. A. Barrett	Lands
J. H. Price	Fire Control
R. W. Beeson	Grazing
E. W. Kramer) B. B. Burnett)	Engineering

California Forest Experiment Station

E. I. Kotok	Director
C. L. Hill, M. R. Brundage, I. J. Mason	Products
W. C. Lowdermilk, H. L. Sundling	Forest Influences
C. J. Kraebel	Ecology and Forestation
D. Dunning, A. A. Hasel, V. A. Clements	Silvics and Forest Management, Pine Region
H. L. Person	Silvics and Forest Management, Redwood Region
A. E. Wieslander, C. R. Clar	Type Map
L. H. Reineke	Mensuration
G. M. Gowen, A. A. Brown, J. R. Curry	Fire Research

National Forest Representative

J. E. Elliott	Forest Supervisor, San Bernardino National Forest

Other Federal Agencies

Office of Forest Pathology

E. P. Meinecke
W. W. Wagener
E. Wright

Office of Forest Insect Investigations

J. M. Miller
K. A. Salman

Office of Blister Rust Control

W. V. Benedict
G. A. Root

Biological Survey

E. E. Horn

Weather Bureau

E. I. Bowie
L. G. Gray

National Park Service

J. D. Coffman

University of California

Division of Forestry

W. Mulford — Dean
F. S. Baker

Division of Soil Technology

C. F. Shaw
G. B. Bodman

State of California

Division of Forestry

M. B. Pratt — State Forester

Forest Extension

W. Metcalf — Extension Forester

Private Agencies

Eddy Tree Breeding Station

L. Austin — Director

CALIFORNIA FOREST EXPERIMENT STATION

General

The 1929 and 1930 reports submitted by the California Forest Experiment Station included an historical statement of the development of the Station's program since its establishment. This year's report is largely devoted to a statement of the progress made during the past year and some suggestions for expansion of the program.

Increased appropriations approximating $29,000 have provided for two new fields, namely fire research and work in the redwood region. It was almost six months before the personnel for this new work arrived, and this delay retarded carrying forward a program already set up for the Shasta fire experimental forest but permitted perhaps a better crystallization of the program itself. The three men assigned to fire research come with a rich and varied experience from the administrative field, representing the diverse conditions of the southeast, northern Rocky Mountains, and California. The Forester selected a special consulting and advisory committee for fire research, representing each of the national forest regions, the Branch of Operation and Division of State Cooperation, who are actively to participate in the formulation of plans and the observation of field conditions in this research work.

The same difficulty in securing personnel delayed initiation of work in the redwood region for six months. The Station was fortunate in having the Bureau of Entomology release H. L. Person for this assignment.

These appropriation increases, together with some slight increases in other appropriations, gave sufficient financial leeway for carrying out the recommendations by previous investigative committees for increasing the personnel in silvicultural investigations in the pine region. Clements was transferred from his Washington assignment for this purpose, and this rounds out the yearlong silvicultural staff for the pine region to three men. The Station has been able to absorb this normal growth without much difficulty. During the past session of Congress funds were appropriated for the initiation of grazing studies and for expansion of the erosion and forest influences investigations. This will add approximately $47,000 more to the Station's appropriations. These increases may appear comparatively large; but experience shows that we shall need to go much further in appropriations to carry forward an adequate program in such extensive fields. Two important fields still remain meagerly provided for, namely erosion and forest influences, and the forest survey. In either of these fields a comprehensive program requires large expenditures for increased field forces or for costly engineering structures and instrumental equipment.

Continued generous and wholehearted support of cooperating agencies has made available funds for the maintenance or expansion of projects now inadequately provided for by Federal funds. The University of California, particularly through its Division of Forestry, the State Board of Forestry, and various southern counties and municipalities have all participated in some of the more important projects of the Station. This cooperation must be valued for more than the mere financial support. Such mutuality of interests of the cooperating agencies undoubtedly is indicative of a public desire to push forward the formulation of sound forest policies for the State, based on the best facts which research can establish.

Personnel

E. I. Kotok	Director

Silvicultural Investigations

C. J. Kraebel, Sr. Silviculturist	Southern California work - forestation, ecology, flood control
W. C. Lowdermilk, Sr. Silviculturist) H. L. Sundling, Asst. Silviculturist)	Forest influences and erosion
D. Dunning, Silviculturist) A. A. Hasel, Asst. Silviculturist (V. A. Clements, Asst. Silviculturist)	Forest management, pine region
H. L. Person, Assoc. Silviculturist	Forest management, redwood region
L. H. Reineke, Asst. Forester	Forest mensuration
G. M. Gowen, Silviculturist) A. A. Brown, Assoc. Silviculturist (J. R. Curry, Assoc. Silviculturist)	Fire research
A. E. Wieslander, Assoc. Silviculturist) C. R. Clar (State Board of Forestry))	State cover type map
R. B. Weaver, Nursery Superintendent	Devil Canyon Branch Station
Earl Morrow, Station Superintendent	Feather River Branch Station

Office of Products

C. L. Hill, Senior Forester, in charge,	Forest Economics
M. R. Brundage, Associate Forester) I. J. Mason, Asst. Forester)	Production and utilization

Cooperating Personnel

J. M. Miller, Sr. Entomologist (Bureau of Entomology)	Forest insect investigations
K. A. Salman, Agent, Bur. of Entom.) R. N. Jeffrey, Agent, Bur. of Entom.)	

Cooperating Personnel (Continued)

G. R. Struble, Asst. Entomologist Albert Wagner, Sr. Scientific Aid, Bureau of Entomology	Forest insect investigations
E. E. Horn, Asst. Biologist (Biological Survey)	Forest Biology

Clerical

D. H. Vinther, Chief Clerk
L. M. Bean, Products Clerk and Lumber Census Editor
L. O. Baxter, Librarian
G. Smith
I. Smith
F. Shuchat

In addition to the permanent force there were employed during the season on project field work some 46 forest students or other short term assistants.

Experimental Forests and Natural Areas

A standing Committee representing the Regional Office and the Experiment Station has been charged with the duty of studying the needs for experimental forests and natural areas, and of reporting annually to the Investigative Committee areas recommended for selection. Final action on the Committee's report on areas recommended at this year's meeting will be taken by August 1, 1931, after conference with Assistant Forester Clapp. The committee's report is as follows:

Experimental Forests and Natural Areas

Wieslander and Dunston spent about three weeks last summer searching for suitable natural areas and experimental forests. Some fourteen or fifteen areas were examined, but it has been decided to submit for the Committee's consideration recommendations on but six proposed natural areas and two experimental Forests as follows:

Proposed Feather River Experimental Forest, Plumas

Location. All or parts of Sections 4, 5, 6, 7, 8, 9, 10, 16 and 17, T. 23 N., R. 10 E., and Sections 31, 32, 33, and 34, T. 24 N., R. 10 E., M.D.M., Plumas National Forest, California.

Area. All of the following area figures are only approximate, but are believed to be sufficiently close for the purposes of this preliminary report.

Government	3970 Acres
Private	-
Total	3970 "

Types.

Western yellow pine	150 "	3.8 per cent
Sugar pine-western yellow pine-Douglas fir	660 "	16.6 "
Sugar pine-Douglas fir-fir	1770 "	44.6 "
Douglas fir-fir	730 "	18.4 "
Brush	660 "	16.6 "
Total	3970 Acres	100.0 per cent

Sites.

I	488	Acres	12.3 per cent
II	1255	"	31.6 " "
III	1393	"	35.1 " "
IV	834	"	21.0 " "
Total	3970	"	100.0 " "

Timber Estimate.

	M Feet B. M.	Feet B. M.
Western yellow pine	14,640	3,690 per acre
Sugar pine	22,741	5,730 " "
White fir	21,995	5,540 " "
Douglas fir	17,866	4,520 " "
Incense cedar	3,818	960 " "
Total:	81,140	20,440 " "

Topography. This is a mountainous area comprising portions of the upper drainage basins of Thompson Creek and Willow Creek, tributaries of Feather River. Elevations range from 4,000 to 6,000 feet. There are numerous springs and streams throughout the area.

Practically all the unit is suitable for tractor and motor truck logging.

Desirability of area for experimental forest.

1. It comprises timber stand conditions representative of the better sites of the Feather River region in which the bulk of lumbering operations on both privately owned and government lands has been conducted.

2. It is favorably located as regards accessibility to main roads, sawmill centers along the Western Pacific Railroad, the Feather River field station of the California Forest Experiment Station and Quincy, the headquarters of the Plumas Forest.

3. The area has not been obligated in the Plumas policy statement to supply any established sawmill.

Proposed Swain Mountain Experimental Forest, Lassen

Location. All or parts of Sections 17, 18, 19, 20, 21, 27, 28, 29, 30, 32, 33, 34, T. 30 N., R. 8 E., M.D.M., Lassen National Forest, California.

Area

Government	4100	Acres (approximate)
Private	-	
Total	4100	"

Types.

Red fir	700	"	17.1 per cent
Red fir-white fir	2780	"	67.8 " "
Lodgepole pine	620	"	15.1 " "
Total:	4100	"	100.0 " "

Sites.

I	640	"	15.6 " "
II	2660	"	64.9 " "
III	800	"	19.5 " "
Total:	4100	"	100.0 " "

Timber Estimate.

Western yellow pine	2,388 M Feet B. M.
Sugar pine	747 "
White fir	56,254 "
Red fir	66,328 "
Lodgepole pine	1,737 "
Total:	127,454 M Feet B. M.
	31,050 Feet B.M. per acre

Topography. Swain Mountain is a low rounded lava mountain with elevations ranging from 6,000 to 6,900 feet. The only perennial stream is Robber Creek, which flows along the northern boundary of this area. There are several permanent springs within the area and a number of shallow stream beds which carry water in the spring months.

Desirability of area for experimental forest.

1. It forms a distinct topographic unit which has not been obligated in the Lassen policy statement or any management plan to supply the needs of any manufacturing center.

2. It is readily accessible to two common carrier railroads which serve the nearby large sawmill centers, Susanville and Westwood, where sawlogs, pulpwood and other wood products can probably be disposed of in the future. These milling centers are also accessible by good auto roads. This is one of the most accessibly situated large government tracts of white and red fir timber in California.

3. Logging conditions are exceptionally favorable. The entire area can be developed for tractor and auto truck logging.

Coppervale Natural Area, Lassen.

Location. Parts of Sections 7, 18, 19 and 20, T. 29 N., R. 10 E., M.D.M., Lassen National Forest, California.

Area. About 2,050 acres National Forest land, including about 200 acres of unpatented mining claims.

Types.

Western yellow pine-white fir	1230 acres	60 per cent
Western yellow pine and Jeffrey pine	820 "	40 " "
Total:	2050 "	100 " "

Sites.

III	1332 acres	65 per cent
IV	718 "	35 " "
Total:	2050 "	100 " "

Timber Estimate.

Western yellow and Jeffrey pine	26,873 M Feet B.M.
Sugar pine	1,373 "
White fir	5,279 "
Douglas fir	564 "
Incense cedar	3,876 "
Total:	37,965 "

Topography. A mountainous area with elevations ranging from 5300 to 6500 feet. There are numerous small drainage units, but only one small stream bed which carries water throughout the greater part of the year.

Desirability for natural area.

1. This is a distinct small timber unit which has not been obligated to supply any mill.

2. The area is typical of the East side slope types of western yellow pine and mixed western yellow pine and white fir.

3. It is very favorably located for research studies since it is traversed by the Susanville-Red Bluff State Highway and is only about 18 miles from the Supervisor's headquarters in Susanville. Adequate protection from fire is assured since the tract is only a few miles from Pegleg Lookout, and is about one mile from the Coppervale Ranger Station.

Butte Creek Natural Area, Lassen

Location. Parts of Sections 32, 33, and 34, T. 32 N., R. 6 E., M.D.M., Lassen National Forest, and Sections 3, 4, 5 and 6, T. 31 N., R. 6 E., M.D.M., Lassen Volcanic National Park.

Area.		
Lassen National Forest	1440	acres
Lassen Volcanic National Park	1920	"
Total:	3360	"

Types.

	Lassen Forest	Lassen Park
Western yellow pine	690 acres	620 acres
Western yellow pine-white fir, red fir	320 "	510 "
White fir, red fir	330 "	790 "
Brush (potential timber land)	100 "	-
Total:	1440 "	1920 "

Sites.

III	70 per cent
IV	30 " "

Timber Estimate. No cruise has been made of the timber in this area. The following stand figures are based on rough ocular estimates made in connection with a logging engineering examination of the Eastern Lassen Working Circle in 1920, and a boundaries examination in connection with proposed Park additions in 1925.

	Lassen Forest	Lassen Park
Western yellow and Jeffrey pines	18,165 M Ft.B.M.	12,075 M.B.M.
White and red fir	17,385 "	32,425 "
Total:	35,550 "	44,500 "

Topography. The area of National Forest land is almost level, with little outcropping lava rock. That within the Park is similar in character except the portion on the slope of Prospect Mountain. Butte Creek, which traverses the area, is a perennial stream

Desirability for natural area.

1. It is typical of the East side plateau types of mixed western yellow and Jeffrey pine, and of western yellow pine, Jeffrey pine and fir, as well as the red fir-white fir type in this portion of California.

3. While the portion within the Lassen Forest forms part of the Eastern Lassen Working Circle which has been obligated to supply the timber requirements of the Fruit Growers Supply Company, it is believed that as a matter of public policy it would be advisable to reserve this area in a natural condition because it adjoins one of the chief centers of scenic interest in the Park, and therefore will be visited by increasing numbers of tourists. Mr. Ansel Hall, Chief Forester of the National Park Service, has also suggested this tract as a cooperative Natural Area.

Proposed Lava Beds Natural Area, Modoc

Location. Parts of unsurveyed sections 12, 13 and 24, T. 41 N., R. 5 E., M.D.M., Modoc National Forest, California.

Area. About 1080 acres, all National Forest land.

Types. All western yellow pine.

Sites.

III	580	acres
IV	500	"
Total:	1080	"

Timber Estimate.

Western yellow pine	17,100	M feet B.M.
Sugar pine	300	"
White fir	1,100	"
Incense cedar	900	"
Total:	18,400	"

Topography. East of the highway which traverses this area, the ground is level to gently sloping with deep volcanic ash soil and very little rock. West of the road is a typical lava flow area with numerous reefs and large patches of lava rock interspersed with small areas of soil in which timber grows.

Desirability for natural area.

1. The portion of this tract east of the highway is typical of the best stands in this type. It is about the only available area in this good type and site quality in government ownership.

2. It is accessibly situated both by highway and common-carrier railroad.

3. With the completion of the Great Northern line, which will pass about two miles to the east of this tract, it is probable that there will be extensive lumbering developments in the government timber of the Lava Beds Unit. Privately owned timber in this locality is being operated on a large scale by the McCloud River Lumber Company and the Weed Lumber Company. Under these conditions, it is very desirable that an area representative of the best stands be retained in a natural state for study purposes.

4. The establishment of this natural area would not interfere materially with any present or prospective lumbering development.

Proposed Mono Mills Natural Area, Inyo

Location. Parts of Sections 4, 5, 6, 7, 8 and 9, T. 2 S., R. 28 E., M.D.M., Inyo National Forest, California.

Area. About 2500 acres, all National Forest land.

Types and Sites. All Jeffrey pine. Predominantly Site V with small areas of Site IV.

Timber Estimate. No estimate has been made. Stands range from about 5 M to 15 M feet B.M. per acre. It is roughly estimated that the area contains 25,000 M feet B.M. of Jeffrey pine.

Topography. Chiefly bench land with gentle slopes. The average elevation is 7000 feet. No streams or springs on the area. A fair dirt road, connecting with the main Owens River Valley highway, passes close to this area.

Desirability for natural area.

1. This area is typical of the better stands of pure Jeffrey pine on pumice soils of the Mono Mills-Owens River Working Circle of the Mono and Inyo Forests.

2. It is situated at the northwestern edge of the working circle, and its retention as a Natural Area would not interfere appreciably with any future lumbering developments.

3. A few miles to the north are extensive old cuttings in similar type where second growth ranges from 15 to 60 years of age. Growth studies will undoubtedly be carried on in these young stands, and it will be desirable to have a virgin check area situated close to these second growth areas.

Proposed Sweetwater Natural Area, Mono

Location. Portions of Sections 2 and 3, T. 7 N., R.25 E., Mono National Forest, Nevada.

Area. About 1900 acres, all National Forest land.

Types. All pinyon pine (P. monophylla).

Timber estimate. No estimate has been made. This is representative of the better virgin stands of pinyon pine and probably averages about 12 cords per acre.

Desirability for natural area.

1. It is close to the Sweetwater Ranger Station and thus can be given close supervision by the District Ranger.

2. This area has been disturbed to a much smaller extent than most other accessibly located tracts in cordwood cutting, although some dead wood has been taken in years past. There was also a small amount of experimental turpentining by the Forest Service about 15 years ago.

Proposed South Fork Tuolumne River Natural Area, Yosemite National Park

Location. Parts of Sections 4, 5, 6, 7, 8, and 9, T. 2 S., R. 20 E., and Sections 32, 33, and 34, T. 1 S., R. 20 E., M.D.M., Yosemite National Park, California.

Area. About 4,000 acres, all National Park land.

Sites. Predominantly site II with considerable areas of Sites I and III.

Types. Sugar pine, western yellow pine, Douglas fir, white fir.
Sugar pine, Douglas fir, white fir.
Douglas fir, white fir.

Timber Estimate. Stands range from 25 M to 80 M per acre and average about 40 M per acre. Roughly this area contains about 160 million feet B.M.

Topography. Mountainous. Elevations range from 5000 to 7000 feet. Well watered by tributaries of the South Fork of Tuolumne River.

Desirability for Natural area.

1. This is an area representative of the best mixed coniferous stands on the west slope of the Sierra range. It contains a wide range of type and stand conditions.

2. Since it is within a National Park, there will never be any pressure to permit any character of timber cutting.

3. So far as is known, the Park Service has no present plans for road development within this tract, nor is camp ground development planned.

The establishment of this natural area as well as any others within National Parks must receive the approval of the Park Service. It is very desirable that

a definite working agreement be reached by the Park Service and the Forest Service on this point. It would appear that this could best be handled through the Forester's office.

During the coming field season, Wieslander and Dunston plan to spend at least three weeks selecting additional natural areas in the Northern Coast Forests and in the sub-alpine types found in some of the primitive areas. If practicable, tentative selections will also be made in non-timbered types.

It appears desirable that the office of Range Management participate in the selection of natural areas next season in order to make sure that they will be suitable also for grazing studies.

It is believed desirable to establish an experimental forest in the East side western yellow pine type. Possibly a satisfactory area can be found near the northern border of the Lassen accessible to the new Great Northern-Western Pacific railroad. It would be desirable also to establish an experimental Forest near the Experiment Station's center of work on the Stanislaus Forest.

Action by Committee

Report approved. Discussion developed the points that there should be another experimental forest in the granite country (southern half of Sierras) and that we should have more brush areas included in such forests, to furnish opportunities for planting and influences studies. There was general agreement that as a basis of further selections we ought to have an estimate of the relative total areas of the forest types to be represented by experimental forests.

Discussion of number, size, and location of natural areas, as influenced by total state areas of types to be represented; by similar areas established by the National Park Service; by insurance against possible wiping out of some areas by fire; by degree of exclusion of other use and restriction of educational use to study by competent scholars, in order to minimize danger of invasion of foreign plant species, and the feasibility of administration necessary for this purpose; by desirability of making such areas biotic units and therefore of giving them natural rather than artificial boundaries, etc., led to recommendation of continuance of the present selection committee and appointment by the Regional Forester of a larger committee to crystallize fundamental principles and policy of natural area selection, as the necessary basis of intelligent further selections.

Note - following the Investigative Committee meeting, the latter committee held a meeting on April 28, and recommends that the following principles be observed in selecting Natural Areas and Experimental Forests in Region 5:

"1. Natural areas may be anywhere from 500 to 5000 acres in size.

"2. Be liberal in selecting Natural Areas rather than conservative.

"3. Two or more moderately sized areas of any particular type are better than one large area.

"4. The size and number of areas selected for any particular forest, or range type, should depend largely upon the importance of the type, and the fire, insect, and other hazards.

"5. A complete list of Natural Areas should be selected in the National Forests. We should not depend on National Park areas, but should encourage the National Park Service to select a complete list of areas covering the National Park types.

"6. It is desirable when possible to select natural areas <u>within</u> established Primitive Areas.

"7. Areas should be selected where there will be the least conflict with Forest uses or users.

"8. Natural Areas should cover a range of <u>sites</u> as well as <u>types.</u>

"9. When possible the boundary of a Natural Area, or an Experimental Forest, should be on topographic lines rather than on survey lines.

"10. Whenever possible a natural area should be established in connection with each Experimental Forest, and in addition to the area required for the latter.

"11. Natural range areas should be selected as well as timber and brush types. Where possible natural forest and range areas should be combined in the same tract.

"12. It is believed that we should cooperate with all other public agencies in California in the designation of a complete range of natural areas covering all of the cover types found in the State.

"13. It is the consensus of opinion that tentatively selected natural areas in the commercial timber belt should be temporarily withdrawn from timber sale activities pending final decision on their selection and classification.

"14. It is important in order to determine the number and size of natural areas to be selected that the total acreage of recognized types in the Region be compiled at the earliest practicable date.

"15. Priority in selection of forest areas should be given to the following commercial timber types:

(a) Sugar pine-western yellow pine-white fir.
(b) Sugar pine-western yellow pine-white fir-Douglas fir.
(c) Western yellow pine-west side.
(d) Western yellow pine-east side.
(e) Western yellow pine-white fir-East side.

"16. Priority in selection of range areas should be given to the following range types:

(a) Bitter Brush - East Slope.
(b) Blue Brush - West slope.
(c) Bunch Grass - East and West slopes.
(d) Oak Browse Type.
(e) Annual Grass Type.

"All field and Regional Office men should cooperate in this work by sending to Lands their recommendations as to forest and range areas in the National Forests of Region Five that should be considered by the men selected to do the detailed field work of examining and recommending the areas to be classified by the Forester. The field should be instructed just what kind of suggestions are desired.

"In view of the interest of grazing in these Natural Areas it is recommended that Nelson be appointed a member of the Committee and that the Committee be empowered to recommend to the Regional Forester such areas reported on as seem to best meet the principles laid down herein and the policy enunciated by the Forester.

"It is recommended that field work be expedited this season to include the tentative selection of the 10 types of Natural Areas enumerated above."

The Regional Forester and Experiment Station Director, with members of their staffs, will decide upon policy and select areas recommended during the coming summer, after consultation with Mr. Clapp on his trip to this region in July.

Silvicultural Investigations

Forest Management - Pine Region

Methods of Cutting (Mc)

There are now 33 methods of cutting sample plots with a total area of 522.7 acres and more than 31,000 numbered trees. With the close of the 1930 field season 14 of these plots have been under observation for 20 growing seasons. A brief description of the plots and summary of results is given in the table and status sheets in this report.

Field work during 1930. Field work was begun May 1, 1930, and was finished October 31. During this period one new plot was established and the 14 older plots were reexamined.

The new plot (Stanislaus 12) was located at Cow Creek in virgin timber near Stanislaus Plot 5. The plot is very similar to Plot 5 before the latter was cut over and was established to obtain growth and other data in virgin timber for comparison with results secured from the cutover stand on Plot 5. To correlate records for the same seasons, each tree on Plot 12 was bored and the diameters calculated for 1923 and 1928, the years of establishment and first remeasurement of Plot 5. A special effort was made to determine accurately the number of trees which died since 1923 and 1928. The plot was mapped in detail and a transect of mil-acre quadrats surveyed and mapped for changes in reproduction and other vegetation.

The older plots examined were Shasta 6 and 11, Plumas 1, Stanislaus 1 to 4, Sequoia 1 and 3 to 6, and Sierra 1. Stanislaus Plots 1, 2, and 4 were resurveyed with a transit, and the boundaries were restaked and cleared again. The area and timber in the north facing slope at the south end of Plot 4 was eliminated so that the area now encompassed represents only one type and site. For the first time since 1916 all new trees in Plots 2 and 4 were numbered. On Sequoia Plot 5 the new trees were numbered for the first time since establishment. Increment borings were made on all the original trees in Sierra Plot 1 to permit dating records back to the year of cutting.

It is felt that these older plots are now in good condition. It is suggested that the next complete examination be deferred until 1940. Records of losses should be recorded in the meantime. This plan would permit devoting more time to intensive observation of the more modern plots and the natural reproduction study.

Considerable work was done on Stanislaus Plots 9, 10, and 11, (The Pickering Woods & Mill Study area) revising the maps to show damage from slash disposal, putting in permanent stakes, etc.

The map and stand records for Stanislaus Plot 8 were checked over and revised in the field to correct a number of discrepancies that appeared during compilation of the preliminary report.

No further field work was done on the Modoc Lava Beds area or the Butterfly area, Plumas, because the lumber companies concerned did no cutting.

Office work. Since November 1, two assistants have been employed compiling data from the 14 plots remeasured during the field season. This work will be completed about April 1. Since January 20 the data have been analyzed and progress reports for each plot are being prepared.

The final maps for Stanislaus Plots 9, 10 and 11 have been completed but tracing and printing has not been done.

The summaries of the original stand, the portions cut and left and other data from Pickering Woods and Mill Study area have been checked and revised for inclusion in the preliminary report on this project completed February 20, for the Regional White fir Committee.

A preliminary summary of the results of cutting and slash disposal on Stanislaus Plot 8 was written, but discovery of errors in the field work makes it necessary to revise this report in part.

Considerable progress has been made in organizing data for the general Mc bulletin but no writing has been possible.

Plans for 1931. Two existing sample plots require attention in the field in 1931. Tahoe Plot 3 should be examined in the spring for records of trees surviving the fire of 1927. Stanislaus Plot 7 should be cruised for losses.

Fire lines should be cleared around all the plots on the Stanislaus.

Stanislaus Plots 8, 9, 10, 11 and 12 and Lassen Plots 1 and 2 should be fenced.

Plans for fencing and clearing of fire breaks are being made in cooperation with Range Management and Operation as part of the unemployment relief program.

In the office progress reports for 20 Mc plots are to be completed, 5 preliminary summaries of new plots must be written and one such summary revised.

The outlines used in the conduct of field work, writing progress reports, and for demonstration to visitors should be revised or completed for all 33 plots. The working plan and the field and office instructions for this project should also be revised.

Before the general Mc bulletin can be written the compilation of 1930 field records and preparation of progress reports must be completed. A large amount of rearrangement and combining of individual plot results must be done. For the first time we now have Hasel and Clements, two permanent men of experience to carry on field measurements and office work so that Dunning can be relieved to the extent that more rapid progress should be made on the bulletin.

Summary of Methods of Cutting Plots

Forest	Plot	Acres	Site	Type	Bd.Ft. Per Acre left	Per-cent Vol. Left	No. of Trees Last Exam.	Date: Es-tab-lish:	Exam. Due
Feather River Center									
Lassen	1	10.0	III	WYP-JP	3260	15.1	139	1922	6-7-32
"	2	10.0	"	"	2240	11.9	123	1922	6-10-32
"	3	10.0	IV	WYP-WF	10260	36.7	970	1927	6-12-32
Plumas	1	24.0	III	WYP	11220	47.5	1550	1911	7-20-35
" F.R.	1	6.4	II	Mixed	18200	45.1	495	1914	6-9-33
"	2	6.4	"	"	26300	48.5	492	1914	6-13-33
"	3	6.4	"	"	14300	27.5	533	1913	6-16-33
"	4	6.4	"	"	23200	40.5	552	1913	6-18-33
"	5	6.4	"	"	14900	28.2	438	1914	6-20-33
"	6	6.4	"	"	15000	27.5	416	1914	6-23-33
"	7	6.4	"	"	22600	40.8	507	1913	6-26-33
"	8	6.4	"	"	25300	34.5	534	1913	6-29-33
Tahoe	3	20.0	III	JP-WF	16000	38.0	629	1911	5-1-31
Stanislaus Center									
Stanislaus	1	20.4	I	SP-WF	19650	28.4	3275	1910	10-12-35
"	2	16.5	"	SP-WYP	22510	38.6	2173	1910	10-20-35
"	3	17.7	"	"	6800	26.6	1338	1910	10-29-35
"	4	13.8	"	"	23480	44.4	721	1910	10-17-35
"	5	10.0	"	SP-WYP-WF	11945	15.5	478	1923	5-16-33
"	6	15.5	"	"	4800	9.8	1242	1927	6-3-32
"	7	160.0	"	"	13314	15.0	-	1927	6-27-31
"	8	8.4	"	SP-WF	14440	16.4	824	1928	6-1-34
"	9	10.8	"	"	10560	17.3	856	1929	9-1-34
"	10	9.6	"	"	34800	55.5	1053	1929	9-1-34
"	11	10.8	"	"	6920	10.6	1251	1929	9-1-34
"	12	5.6	"	SP-WYP-WF	-	100.0	432	1930	5-11-35
Shasta Center									
Shasta	6	25.0	III	WYP	9900	33.8	1516	1911	8-12-35
"	11	10.9	"	WYP	6340	28.6	934	1911	8-4-35
Sequoia	1	10.0	I	SP-WF	13370	25.8	1503	1911	9-16-35
"	3	10.0	II	WYP	11350	47.4	1039	1911	9-5-35
"	4	10.0	I	SP-WYP	21550	48.4	2123	1911	9-1-35
"	5	10.1	"	"	8735	-	1162	1911	9-4-35
"	6	10.0	"	WYP	13100	41.0	972	1911	8-26-35
Sierra	1	6.0	"	WYP	12830	28.2	1047	1911	9-23-35
Total	33	522.7					31317		

Natural Reproduction (Mr)

Field work during 1930. Of the 1740 established mil-acre quadrats, 1540 were recharted in 1930. In addition 40 new quadrats were established in the new uncut control plot, Stanislaus 12. Of the inventory transects 88 chains were retallied on the Mc plots examined. The accompanying tabulations show the location and character of these quadrats and transects.

For 78 of the quadrats on the Stanislaus the herbaceous vegetation was also charted, principally by Beeson of Range Management.

The 174 screened and unscreened plots on the Stanislaus were reseeded in October and November with SP, WYP and WF seed collected nearby.

Little change was apparent on most of these plots. Most of the seedlings which germinated in the spring of 1929 were dead from drought. As there was practically no seed in 1929, few new seedlings were found in 193(With rare exceptions, the seedlings under screens did not survive.

On the plots where seed crop counts have been made in the past there was scarcely any seed matured in the fall of 1930.

Little work was done on the study of root competition. Some 1929 seedlings were excavated and photographed in May 1930, one year after germination, to determine the depth of root penetration. Western yellow pine seedlings had roots reaching to a depth of 21 inches in the Stanislaus soil. The maximum depth for white fir was about 18 inches.

Several additional soil profiles were sampled in various Mc plots on the Stanislaus.

Office work 1930. A statistical analysis of the Mr quadrat records was begun by Reineke about February 1. The object is to determine how many of the quadrats should be charted annually to attain a reasonable degree of accuracy in number of seedlings. We also wish to determine how closely the areas of different types of cover on the detailed quadrats compare with similar areas on the larger plots in which the transects are located. If the transect maps give reasonably reliable data on cover it will be possible to dispense with the expensive mapping of the larger plots.

Plans for 1931. All of the 1780 mil-acre quadrats will be charted again beginning about June 15. It is hoped Range Management will continue to chart the forage vegetation on the Stanislaus or that the proposed personnel to be assigned to the Station for grazing studies will take over this phase of the work.

The seeded screened plots will be examined in the spring and reseeded in the fall. Seed crop counts will be repeated if any seed appears.

The need for closer observation of the factors affecting natural reproduction become more apparent each year. The measurement of important physical factors during critical periods is especially necessary before real progress can be made. Knowledge of the progressive changes in soil moisture and soil and air temperatures under varying conditions are badly needed. It is believed that worth while results could be secured if a temporary assistant could be maintained at the Stanislaus Branch from about April 15 to October 31 for observation in the sugar pine-fir type only. Two sets of instruments and equipment for soil moisture determinations would be located on a clear cut area, the other nearby in a fairly heavy stand of similar type left after a Forest Service sale. Most of the equipment is already available.

It is suggested again that a general survey of natural reproduction is desirable. The continued failure of seed crops and the sequence of dry seasons have delayed results from established plots. It is believed that information of immediate value could be obtained by searching out locations where good stands of reproduction have become established in the past and making careful analyses of the conditions existing there. The data would also provide seedling growth curves for the several species which are needed in yield studies and damage appraisals. Such a project could be carried this season because few of the permanent plots require attention.

In the office all data from permanent reproduction plots need to be summarized in form for use of the Mc bulletin. Reineke's statistical work will be continued and planimetering of the quadrat maps will proceed as soon as work on the larger plots is finished.

Miscellaneous Plots Examined at Irregular Intervals.

Forest	Location	Type	Site	Cutting	
California	Kern Ridge	Brush & timber	IV	Burned 1920 -	7 small plots charted for replacement of timber by brush after fire.
Eldorado	Pino Grande	Mixed	I	1907-heavy; burned 1920 -	47 chains transects mapped for reproduction after logging and burning.
Modoc	Egg Lake	Mixed	III	Burned 1919 -	5 chain transect for survival and replacement.
Plumas	Mc, F.R. 1 - 8	Mixed	II	1912-13-Fs-Lt.	6 plots with counts in 5 ft. by 5 ft. squares.
Sequoia	Mc, Pl. 3	WYP	II	1907-Fs-Light.	4 circles -50 ft. radius.
"	Pl. 4	SP-WYP	I	" "	" " "
"	Pl. 5	SP-WYP	I	" "	" " "
"	Pl. 6	WYP	I	" "	" " "
Shasta	Mc, Pl. 6	WYP	III	1910-Fs-Light-	2 acres counted in 5 ft. by 5 ft. squares.
"	Pl. 11	WYP	III	1910-Fs-Light	do.
Stanislaus	Miners Ditch	SP-WYP-WF	I	1922-Fs-Mod.	160 chains inventory strip for logging damage.
"	Jordan Cr.	WYP	I	Uncut	2 acres mapped, part in detail for influence of bear clover on reprod.
"	Mc, Pl. 1	SP-WF	I	1910-Fs-Light-	2 circles 30 ft. radius for survival after logging.
"	Pl. 2	SP-WYP	I	"	do.
"	Pl. 3	SP-WYP	I	"	"
"	Pl. 4	SP-WYP-WF	I	"	"

Summary of Natural Reproduction Plots

Charted mil-acre quadrats

Forest	Location	Type	Site	Cutting	No.	Note
Lassen	F.G.S.Co.	WYP-WF	IV	1928-Fs-Moderate	200	
Plumas	Mc, Pl. 1	WYP	III	1911 Fs-Light	800	fenced
Stanisl.	" 5	SP-WYP-WF	I	1923 Fs-Moderate	200	"
"	" 8	SP-WF	I	1928 Fs-Moderate	140	
"	" 9	SP-WF	I	1929 Fs-Moderate	100	
"	" 10	SP-WF	I	1929 Lt.Econ.Sel.	100	
"	" 11	SP-WF	I	1929 Heavy	100	
"	" 12	SP-WYP-WF	I	None	40	
"	P.L. Co.	SP-WF	I	1927 Clear	100	
				Total	1780	

Screened and unscreened seeded plots

Stanisl.	Mc, Pl. 5	SP-WYP-WF	I	1923-Fs-Moderate	18	fenced
"	Branch Cbn	WYP	I	Uncut	36	
"	P.L. Co.	SP-WF	I	Clear	60	
"	Mc,Pl. 8	SP-WF	I	Fs-select	60	
				Total	174	

Inventory transects

Lassen	Mc, Pl.1	WYP-JP	III	1921-Fs-Moderate	20	chains
"	" 2	"	"	1921-Fs-Heavy	20	"
Sequoia	" 1	SP-WF	I	1911-Fs-Light	10	"
Sierra	" 1	WYP	I	1906-Fs-Moderate	12	"
Shasta	" 6	WYP	III	1910-Fs-Light	28	"
"	" 11	WYP	III	1910-Fs-Light	20	"
Stanisl.	" 1	SP-WF	I	1910-Fs-Light	20	"
"	" 3	SP-WYP	I	1910-Fs-Light	20	"
"	" 5	SP-WYP-WF	I	1923-Fs-Moderate	20	"
"	" 9	SP-WF	I	1929-Fs-Moderate	20	
"	" 10	SP-WF	I	1929-Fs-Econ.Selec.	20	
"	" 11	SP-WF	I	1929-Fs-Heavy	20	
Tahoe	" 1	SP-WF	III	1910 Shelterwood	20	
				Total	250	

Summary of Thinning Plots

Location	Plot	Type	Age	Site	Area acres	Number trees	Date established	Thinning method	Exam. Due
Klamath	1	DF	50	II	1.00	295	Fall, 1912	Moderate	9/1932
"	2	"	50	"	1.00	609	"	Control	"
Feather	1	WYP	53	"	0.45	593	Sep. 1919	German-Md	9/1934
" River	2	WYP	43	"	0.44	585	"	Control	"
"	3	"	56	"	0.41	210	"	German-Md	"
"	4	"	56	"	0.55	233	"	Control	"
"	5	"	28	III	0.23	1437	"	Control	"
"	6	"	28	"	0.29	358	"	German-Lt	"
"	7	"	28	"	0.39	446	"	German-Hvy	"
"	8	"	28	"	0.34	511	"	German-Md	"
Quincy Jct.	A	"	43	"	0.51	311	May, 1930	German-Md	5/1935
"	B	"	43	"	0.37	254	"	French from below	"
" "	C	"	43	"	0.43	258	"	Cotta	"
" "	D	"	43	"	0.45	396	"	Control	"
" "	E	"	43	"	0.55	463	"	Control	"
" "	F	"	43	"	0.33	150	"	Berrgreve	"
Stanislaus	1	SP-WF	52	I	0.66	384	June, 1921	Mod. from below	6/1931
"	2	"	52	"	0.40	451	"	Control	"
Westwood Jct.	1	WF	75	III	0.25	140	Sept. 1927	Moderate from below	9/1932
"	2	"	75	"	0.25	211	"	Berrgreve	"
"	3	"	75	"	0.25	68	"	Danish	"
"	4	"	75	"	0.19	218	"	Control	"
Total	22				9.74	8581			

Methods of Thinning (Mt)

No field work was done in the thinning study during 1930.

In the office the summaries for the first two 5-year periods were completed.

In 1931 two plots on the Stanislaus are due for remeasurement. All summaries must be checked and progress reports written. Summaries for field use need to be revised.

Yield Studies (ME-6, 101, 161, 167)

Permanent yield plots. No field or office work was done in connection with the permanent yield plots in 1930. No examinations are due in 1931. Progress reports and summaries for field use must be drought up to date.

Summary of Permanent Yield Plots

Forest	Plot	Site	Type	Age	Area	Number trees	Date established	Exam. due
Plumas	1	II	WYP	56	1.08	605	1919	1934
Shasta	1	II	WYP	34	0.50	289	1918	1933
Tahoe	1	I	DF	52	0.42	253	1923	1933
Stanislaus	1	I	WF	75	0.50	177	1923	1933
Total	4				2.50	1324		

As soon as the Mc summaries are completed, Clements will devote most of his time to the Mt and ME projects so that more rapid progress may be expected this year.

Preparation of yield tables (ME-4). Reineke finished the analysis of the influence of composition on yield in mixed even-aged second growth stands. The presence of western yellow and sugar pines tends to increase the yield above the average, while Douglas fir tends to reduce yield. White fir and incense cedar are about average in their effect.

Analysis of the complex effect of mixed-species stands was made by preparing a yield table of standard type for the average conditions of composition and density and then analyzing the departures from that table caused by composition and density differences. The manuscript will be submitted for publication at an early date.

Mensuration Tables.

Very little work was done on mensuration tables in 1930. Professor Schumacher's transfer to Washington interrupted the work of checking regional tables. When the more urgent parts of the Stanislaus woods and mill study are completed data will be abstracted from the log and tree forms and sent to Washington for checking the regional tables and the proposed new log rule.

The possibility of using to advantage curved heights in timber estimates instead of estimating the height of each tree is strongly suggested by recent work in connection with the Mc plots. The nearly uniformly low estimates may have considerable influence in lowering stumpage rates in appraisal. The principal cause of low estimates is believed to be erroneous estimation of heights combined with improper deduction, for degree of utilization, breakage, and cull. If recording of heights can be dispensed with, the trees could be recorded by tree classes so that reconnaissance records would show directly the degree of cutting advisable for any unit. This system is now used in R-6.

The Stanislaus woods and mill study data and other sample plot records provide material for analysis of the subject.

Action by Committee

The Committee approved the proposed program, and specifically the omission of remeasurement of the older Mc plots until 1940, with the proviso that, should there be a marked climatic change in the meantime, such as return to a wet cycle of years, remeasurement would then be made, so as to secure a clear-cut record of the drouth period in which we have now been for the last 15 years.

Forest Management - Redwood Region

Investigations in the redwood region were begun by the Station in December, 1930, with the transfer of Person to the Station staff. As it is probable that the redwood studies will develop into long term projects of increasing size and importance it seemed advisable to spend several months on a general preliminary survey before a definite program is decided upon.

Silvical studies in the redwood region will naturally be somewhat similar to those in the pine region, particularly in the extensive use of permanent sample plots or strips. Obviously a great amount of time can be saved by concentrating these plots close to definite field centers and for this reason no permanent plots will be established until our field centers are selected.

Another point that should be settled before a program is set up is how the work of the Station is to be correlated with that of other agencies now working in the redwood region. Up to the present, agencies other than federal have played the major part in the development of forestry in the redwood region. Since it is the policy of the Forest Service to aid rather than to interfere, the Station contemplates beginning its work on those problems which are least likely to be handled by the other agencies. There is also the possibility of cooperative projects with one or more of the existing agencies.

Although the range of the redwood has been quite definitely established our definition of what constitutes the redwood region is subject to change. At present it is probably best to confine our efforts to the commercial range in the four north coast counties, Del Norte, Humboldt, Mendocino, and Sonoma.

Preliminary Studies

For the reasons just mentioned the first step should be a general study of the problem which will serve as the background for later work. This will logically include (1) a review of the literature and the preparation of a complete bibliography; (2) interviews with those who are in a position to give information pertaining to the redwood region; and (3) trips in the field which will supply the first-hand knowledge of the problem which is desirable before any long term program is undertaken. This preliminary survey will also include (1), the accumulating and preparing of maps needed to illustrate the present status of forest growth in the redwood belt so far as our present knowledge permits.

The following outline, therefore, covers only this preliminary study of the problem.

1. Review of literature

This review has not been confined to references to redwood, but has also included, so far as we have gone, many references to the redwood belt, its history, geology, climate and industries, as well as its forests. A large part of the titles, which now number over 1,100, were taken from the following sources:

a. The California Forest Experiment Station index, which has been built up largely by Dunning.
b. The Products index, maintained by Hill.
c. The bibliography of the forestry school of the University of California.
d. The bibliography prepared by Merriam for Mason and Stevens.
e. Dr. Meinecke's index to forest pathology literature.
f. Index of the Journal of Forestry.
g. The card catalogues and periodical indexes of the University of California and Stanford.

It is also planned to review the indexes at the Regional Office, and the Dudley Herbarium and the Branner library (of geology) at Stanford.

2. Interviews with those interested in the redwood study

A number of men have already been interviewed and it is planned to see as many more of the following groups as is possible.

a. Station staff.
b. University of California faculty members, Divisions of Forestry, Botany, Soil Technology, Geology, Geography, and Palaeonthology.
c. Lumber Association staffs.
d. Consulting and industrial foresters.
e. Redwood operators, timber-owning non-operators, loggers, and forest engineers.
f. Southern Pacific Company, Land Department.
g. Save-the-Redwoods League.
h. Carnegie Institution.

3. Field work.

The following objectives will be kept in mind in planning field trips:

a. Location of suitable areas for centers of work. At least one such area should be selected before any sample plot studies are started or any definite program decided upon, so that as much of the field work as possible can be planned within a reasonable distance of the "center".
b. Trips with men acquainted with the redwood area and operations should be planned, so as to acquaint Person with as many of the men in the industry, and as much of the country, as possible.
c. Extended field trips should be made for the purpose of gaining a thorough knowledge of all phases of redwood operation, logging, milling, grading, seasoning, etc. The possibilities for improvements, particularly of silvicultural practices, should always be kept in mind.
d. Areas of special interest as illustrative of results of planting (survival, etc.), stand establishment, and survival under different conditions with respect to logging methods and use of fire, conditions of yield, etc., should be examined and mapped.

4. Maps.

The lack of any reliable base maps for most of the redwood belt is a real handicap. Geological and soil surveys as well as work on the forest type map have been delayed for this reason. This makes it all the more necessary to acquire as many different types of maps of the area as possible and to work up a map which will show the following as accurately as our present knowledge will permit:

a. Redwood distribution, virgin and cut-over, and types where available.
b. Ownership map for entire redwood belt.
c. Areas of special interest.
    All planted areas.
    University of California experimental areas.
    Areas showing the effect of different logging and burning methods on vegetation of soil.

These maps, together with field work, will form the basis for selection of centers of work.

Redwood Projects

The work on the preliminary survey of the redwood problem is well started and will be largely completed within the next few months. The following projects are proposed to supplement the field work outlined under the preliminary studies.

1. The comparative merits of artificial and silvicultural reforestation.

It would be unwise to start any project except on a small scale until a definite program has been worked out. However, it seems very probable that any silvicultural studies undertaken will have some bearing on the problem of restocking after logging and any observations that can be made in connection with the general study of the area will be of value.

This study should be limited, for the present, to the following two points:

a. Effectiveness of planting. This should include the examination of most of the planted areas and a determination of survival and vigor on sample areas. Survival of the different species according to class of stock, slope, exposure, soil, and ground cover should be determined.
b. Possibilities of securing reasonable stocking by slight changes in logging methods. The fact that Gibbs, a company forester, by careful supervision, was able to save 50% of the seed trees left on an area where Mason's selection system of cutting was practised - in spite of logging damage and slash burning - shows that seed trees can be left. The practicability of this method of securing reproduction is still to be proved.
The preliminary studies should be limited to the examination and study of the logging and burning methods of the more progressive companies, to determine whether it is possible to leave enough seed trees without excessive cost or radical changes in methods.

2. Forest type map - cooperation with Wieslander.

It is evident that it will be a number of years before the U. S. G. S. topographic quadrangles for the three northern coast counties are completed and it is equally certain that type mapping on the standard used for the remainder of the state is not possible without these base maps.

Rather than hold up the preparation of a state map until this standard can be obtained it is proposed to map areas having no base maps on a less detailed basis for use until greater accuracy can be obtained.

By supplementing these maps now available or obtainable through the lumber companies, county assessors, and others with a limited amount of field work, the redwood area can be mapped in sufficient detail to be incorporated in the map of the state as a whole which is now largely completed.

In obtaining the necessary data, under Wieslander's supervision, a knowledge of the redwood country would be acquired which would be of great value in all subsequent work.

3. Cooperation with the office of Products on going or proposed utilization projects.

Studies such as those on the relation of growing conditions, - density of stand, rate of growth, quality of site, etc. - to wood properties would be particularly adaptable to such cooperation.

Action by Committee

The Committee approved the project leader bending his efforts toward such work as would help in respect to the type map. The taking up of a survey of redwood planting was agreed to be justified, in order to take advantage of the knowledge of lumber company foresters who are in danger of being discontinued, if it is done without committing the Station to any formal project, and realizing that the location of our centers of work is the first job.

Forestation

Since the nursery and planting activities were set forth in some detail last year, only a brief report will be made at this time.

Northern California

By agreement with the Regional Office of forest management we are continuing the production of planting stock at Feather River Nursery to supply small planting projects of several forests. The output in 1930 was 32,900, although this figure was reduced considerably by heavy culling of under-developed stock. Last October's inventory of 1-0 seedlings showed a total of 66,000 on hand. The production aimed at is 80,000 annually of which western yellow pine will constitute more than half, sugar pine one-fifth and Jeffrey pine, white fir and miscellaneous species the remainder.

Experimental plantings by the Experiment Station are being continued as far as the limited personnel allows, particularly in the direction of reforesting burned areas where brush competition is a problem.

In the nursery a fertilizing experiment is being undertaken in an effort to produce more uniformly vigorous stock. The hope that a soil analysis might prove a short-cut method of discovering a deficiency in the Feather River soil was not quite realized.

Southern California

At Devil Canyon Nursery our cooperative agreements with the southern counties and the State Forester require the distribution of planting stock on a scale which gives ample opportunity for the conduct of nursery and planting experiments under practical conditions. The demand for stock from San Diego and San Bernardino counties continues to exceed our output, but since there are evidences that this would be true no matter what the output, we do not propose any immediate expansion.

Planting experiments during 1930 were extended to an old burn in the mixed conifer type at 6,000 feet altitude in the San Bernardino Forest which is not reproducing and is threatened with conversion to brush. The plantation of March 1930 showed the following survivals in November:

Coulter pine	80%
Knobcone pine	20%
Western yellow pine	86%
Jeffrey pine	88%
Sugar pine	50%
Incense cedar	88%
Bigtree	80%

The planting site is traversed by a popular new highway which receives heavy recreation travel, and is adjacent to an area assigned to local public-spirited organizations who are anxious to do some planting in the forest. The results of the experiments are already useful in giving direction to this praiseworthy enthusiasm. The planted area is intended for ultimate use for recreational activities.

With regard to planting technique our present effort is to produce deep-rooted plants and a satisfactory method of getting such plants properly into the ground in such a way that their principal absorbing rootlets will begin functioning below the active "evaporation horizon" of the soil, i. e. the upper 8 or 10 inches. With bare-rooted stock the cost of digging holes for such planting is excessive; with potted stock in 3 x 10-inch paper pots the desired objective is scarcely reached. Experiments with deeper pots of small diameter are being started this spring, using bottomless tubes of light galvanized iron from which it is expected the plants can be set into holes of minimum size dug with a bar.

The search for succulent species having some promise of usefulness for firebreak cover has been continued and during the year has directed attention to two species of Euphorbia. Through the tropical plant acclimatization garden of the Bureau of Plant Industry at La Jolla we are receiving cuttings of Euphorbia tirucallii, and hope to secure Euphorbia intisy as soon as that rare plant becomes available in sufficient quantities. The intisy plant is reported, by Plant Explorer Dr. Charles Swingle, to thrive under extremely arid conditions and on poor soil. Since it is a succulant these qualities mark it as desirable for trial as a firebreak cover.

This spring will be made our first outplanting in a firebreak of two species of ice-plant (Mesembryanthemum) which we have been propagating at the nursery for several years. Experience in the nursery has demonstrated that the large-leaved species is relished as food by rabbits and birds. A portion of the plantings will be caged against expected depredations from these sources.

Last year's effort to propagate the native Rhus ovata from cutting was rewarded with a few successfully rooted plants. This work will be continued along with the general program of propagation of native chaparral species.

Nursery experience and the many plantings made about the Devil Canyon Station since 1927 are now reaching a stage which enables us to eliminate unpromising species and concentrate attention upon the more desirable types. This is particularly true of the numerous conifers which we have tried in cooperation with the Eddy Tree Breeding Station. Of hardwood tree species, osage orange, Arizona ash, and Chinaberry (umbrella tree) have survived surprisingly well in wind-break plantings.

Action by Committee

The discussion centered upon the undertaking of research of planting on the west side. It was agreed that nothing further could be accomplished without attacking this problem on a much larger scale than in the past. A motion was carried that the Committee urge the assignment of a man to the Experiment Station for special prosecution of planting research in respect to the west-side Sierras.

California Cover Type Map

1930 Progress

Progress made in field mapping and the large measure of cooperation secured from interested agencies are indicated in the following table:

Project Location	Cooperation	Number of Townships Mapped
Outside areas Los Angeles County	County Forester provided 2 men and 2 cars for 2 months	10
Liebre Burn, Angeles National Forest	County Forester provided 1 man and car	1
Outside areas, Riverside County	State Forester provided 1 man and transportation	15
Outside areas, San Bernardino County	State Forester provided 1 man and transportation	1
Mill Creek and Cajon Burns, San Bernardino National Forest	Forest Supervisor provided 1 man and transportation	1
Monterey County Unit, including Monterey Division of Santa Barbara National Forest	State Forester provided 1 man and transportation for 1 month	29
Cleveland National Forest	Mapped by District Ranger of Palomar District	4
Santa Barbara National Forest and outside areas in Santa Barbara, San Luis Obispo, Kern, and Ventura Counties	Forest Supervisor provided equivalent of 3 man months and transportation, also Government pack stock for Experiment Station crews. Regional Forester provided 2 men for approximately 3 months, also truck for Experiment Station Crew.	132

Project Location	Cooperation	Number of Townships Mapped
Tehachapi Mountains	State Forester provided 1 man and transportation	10
Total		203

Approximately 60 man months of field work were required to map the 203 townships in contrast to 40 man months and 80 townships in 1929. The increased accomplishment per man month in 1930 is accounted for to some extent by the relatively easier accessibility as a whole of the area covered in 1930, but most of the gain is due to the retention of experienced men. In 1929 it was necessary in all cases to train new men, while in 1930 it was possible to organize the work so there was an experienced man in each crew.

The foregoing includes all field work done under the direct supervision of the Experiment Station. Progress made by the Forest Supervisors in typing their respective forests will be reported by the Regional Office of Forest Management. Other areas mapped by cooperators should be mentioned here. Some 23 townships on the Shasta National Forest were typed in connection with the topographic survey being made by Mr. Littlefield of the Regional Engineer's office. Similarly, the United States Geological Survey typed 12 townships in their topographic survey of the Honglin Quadrangle in Trinity County. On the Eldorado National Forest the Office of Blister Rust Control secured type data on the area covered by their Ribes survey and on the Plumas National Forest areas covered by the reconnaissance part of the Regional Office of Range Management also mapped types in conformity with the cover type project. The National Park Service has a program for remapping to present standards the three National Parks already extensively mapped. It is understood that progress was made during 1930 in remapping the Lassen and Yosemite National Parks and that the Park Service can be counted on to complete their part of the program by the time adjoining National Forest areas are mapped.

Supplemental Data for Forest Survey

In August 1930 Director Granger of the Forest Survey suggested at a conference with Woodbury, Kotok, Dunston, and Wieslander that certain additional data be secured for adapting the cover type map to the needs of the Forest Survey. This would mean material slowing down of field work in timbered areas but would obviate necessity of covering the ground a second time. Revised instructions were therefore prepared and sent to the National

Forests providing that the following data be shown on a tracing overlay on the type map:

1. Cut-over land. Includes all logged lands whether burned or not.

   a. Selectively logged areas with a residual stand sufficient to justify a second cut prior to the maturity of the reproduction.

   b. Clear cut areas which are restocked to seedlings and saplings subdivided as well, medium, or poorly stocked.

   c. Clear cut or burned over logged areas which are not restocking (no visible reproduction).

2. Burns. Lands not cut over on which the stand has been killed by fire.

   a. Areas recently deforested by burns which have not yet developed into brushfields or other non-coniferous fire types.

   b. Brushfields and woodland areas that are restocking to coniferous timber subdivided as well, medium, or poorly stocked.

   c. Brushfields with no visible reproduction.

3. Non-commercial rocky areas within timber types.

4. Site classification of all forest or potential forest land.

Map Publication.

During the year there was correspondence between the Washington Office and the Experiment Station regarding publication of the type data. It was tentatively decided that generalized type data be shown on a State base map (scale 1 inch equals 12 miles) and that detailed type data be shown as an overprint in color on 30 minute U. S. G. S. quadrangles (approx. scale 1/2 inch equals 1 mile). A large part of the State is covered by 15 minute quadrangles (approx. scale 1 inch equals 1 mile). Where this is the case, it was considered advisable to reduce four 15 minute quadrangles to one 30 minute quadrangle in order that the series of cover maps be of uniform scale. This reduction would necessitate elimination of contours. The cost of printing is estimated at about $900 per quadrangle edition of

500 copies. The size of the printing job is indicated below:

Status	:Number of :Quadrangles
Cover data now complete	15
*To be completed - 1931	20
*To be completed - 1932	45
To be completed when topographic surveys are made	40
Total	120

*Large areas now mapped but data not complete for any full quadrangle.

Program for 1931

The Experiment Station assignment to the cover type project will consist of Wieslander and 4 field men, involving an outlay for salaries and expenses of approximately $14,000. This does not include clerical and overhead charges. This assumes that one field man will be carried as Junior Forester beginning July 1. With the retention of 4 experienced field men and the assistance secured from the Regional Forester and State Forester this winter the accomplishment for 1931 should be equivalent to that of 1930, approximately 200 townships. There follows a brief mention of the specific projects to be worked on.

1. Completion of southern California, including Tehachapi Mountains.

With five 2-man crews (2 provided by Regional Forester, 2 by Experiment Station, and 1 by State Forester) on the job until April 15, and 2 crews after that date, this project should be completed by July 1.

2. Mapping of Inner Coast Ranges south of San Francisco Bay.

Upon completion of work in southern California one crew will be assigned to this region and should map about 50 townships. There is a possibility of a second crew being also assigned to this region later but this depends on amount of work involved in project No. 3.

3. Cooperation in Land Use Study of Eldorado County.

In connection with a land use study being made by Professor Weeks of the Giannini Foundation we agreed to cooperate on the timber phase of the study and to provide among other things a cover map and timber inventory of Eldorado County. A total area of 48 townships is involved, 21 of which are outside the National Forest. Since this outside area was the initial area mapped on the cover type project and very extensively done, remapping to present standards is required. To do this one crew will be assigned. How the timber inventory is to be secured is yet to be decided. It would seem desirable to use a strip system comparable to that of the Forest Survey that is to come later so that the data secured will not only be useful to the study at hand but can be incorporated as a part of the statewide Forest Survey.

4. Extensive mapping of the Redwood Region.

In the Redwood Region intensive type mapping is precluded by the lack of topographic maps. To wait for these surveys would long delay the publication of the generalized small scale state cover map. It is therefore proposed to cover such areas extensively with the idea of securing data of sufficient accuracy for the small scale state map. Mr. Person, who has been assigned to research in the Redwood Region, is planning on mapping as much as possible in this region in connection with exploration trips in his new field of work.

Action by Committee

Report approved.

The Committee agreed upon the desirability of mapping by U.S.G.S. quadrangles, where necessary, or by groups of quadrangles, rather than to sacrifice desirable detail in fitting different areas to the same scale. The Chairman was instructed to appoint a committee to confer with the State Department of Public Works and the U.S.G.S. and present Forest Service priority preferences in topographic mapping, under the enlarged program recently assured, in order to facilitate the progress of the Station type map. The Chairman was also instructed to send a letter to the State Forester for transmittal to the State Board of Forestry expressing appreciation for the past cooperation of the State in the type map project and hoping that this cooperation will continue.

The discussion of Forest Survey money, taken up at this time, was chiefly with respect to its use on the furthering of the Type Map, starting Requirements study, or obtaining cruise data on stands. A vote favored the devotion of the $5,000 such as was obtained last year to the furtherance of the Type Map and especial consideration to be given to the possibility

of getting at least one quadrangle printed as a sample to show the value of the work and perhaps raise interest enough to bring cooperative contribution for further publication. The importance of starting a study of Requirements was recognized and such work was approved if it were possible to get an additional appropriation up to $15,000.

Forest Influences and Erosion.

Research under Forest Influences and Erosion is divided into four projects. They are:

1. Water cycle and erosion studies, by tank experimentation
2. Surface run-off and erosion studies, by plot experimentation
3. Watershed studies, by surveys and specific watersheds, including duplicate watersheds
4. Water - soil - plant relations, studied by various experimental methods, including laboratory and field installations.

Water Cycle and Erosion (Tank experimentation at Berkeley).

a. Installation A is the old set-up of 8 tanks which were employed for studies of the influences of forest litter. This installation has been maintained for readings under natural rainfall. No special runs were made.

   It is proposed to recondition this installation and to refill the tanks with different soil series for further studies of the effect of forest litter on run-off and erosion.

b. Installation B is the set-up to measure the relative influence of grass and forest litter on surface run-off and erosion. Grasses (Bromus hordeaceus and Hordeum sp.) were planted in duplicate tanks. The center tank is covered to chaparral litter. A series of runs were made, and the effect of natural rains has been followed by daily readings. The data have not thus far been analyzed.

   It is proposed to analyze the data, and continue the experiment.

c. Installation C is set up to measure the effect of gradient of bare soil surfaces on surface run-off and erosion. One series of experimental runs has been completed for the Aiken soil series sample. The results have been reported in manuscript.

   A second sample of soils, derived from serpentine rock, has been placed in the tanks and is being allowed to weather settle through the present rainy season preparatory to experimental runs in the spring and summer of 1931.

It is proposed to continue this experiment in accordance with the working plan.

d. Brush tanks. It is further proposed to install in Strawberry Canyon two sets of large tanks, each to contain 5 cells, each with the following dimensions: 6.6 feet wide, 13.2 feet long and 5 feet deep. These tanks are for study of the role of brush vegetation on the water cycle as compared with grass and bare surfaces. A working plan has been prepared.

Surface Run-off and Erosion (Plot experimentation).

Barranca installation. This is the oldest installation, dating from 1927. Separate clock-driven recorders have been employed for the two pairs of plots. Difficulties in synchronization of records have been encountered and led to the adoption of the multiple electrical contact recorder now used in the other three installations.

The run-off records of the storms recorded at this installation are all plotted. The summary record is shown in a table covering the four years of record. Vegetative succession has been recorded which indicates the development of a thin layer of litter, and a cover consisting of chaparral shrubs and an intermediate mantle of herbaceous and graminaceous vegetation. It is apparent that the ratio of surface run-off from burned to that from covered plots has changed, and has even been reversed. Equilibrium has been practically established on the burned plots. The reversal in run-off record can in part be explained by the baring of the lower ends of the covered plots through the effect of wind in whipping shrub branches. This experience suggests for future experimentation a protection zone of vegetation between baffle troughs and the recording installation.

It is proposed that this installation be abandoned and that all data of run-off record and vegetation be worked up for a final report. The instruments are to be adapted to the multiple recorder type for another installation which is proposed below.

Panorama installation. The Panorama installation was made in 1928, and was run one year with separately driven recorders. In 1929 a multiple recorder was installed. Run-off records of this installation have been plotted to date. A summary table has been made, setting forth the results by years and by storms. The ratio of run-off from the burned plots has rapidly fallen off to approximate equilibrium for the two pairs of plots.

Vegetation consisting chiefly of Quercus dumosa returned rapidly

by sprouting. Herbaceous vegetation filled spaces and helped form an effective though thin litter. Erosion by creep continued during the year of 1929-30 more conspicuous on the burned plots than on the covered plots, although it was noticeable on the covered plots.

It is proposed that this installation be continued. If funds are available, two additional plots should be installed, and the present burned plot be recut and burned. If funds are not available, it is proposed that the present burned plots be recut and reburned to bare the surface for another series of comparisons.

San Dimas installation. The San Dimas installation was made in February, 1930. Run-off records for all storms to date have been plotted. Although the slope of the burned plots here is high (40%) yet the rate of run-off under intensities of rain up to rates of 7.6 inches per hour for two minutes is less than for the Barranca and Panorama installations. High contents of organic matter in the surface soil, which was not burned by the fire, when the soil was wet, is presumed to account for the comparatively high absorptive capacity of this soil. Continuation of the experiment with means of producing a bare mineral soil surface is, therefore, indicated. Erosion from the burned plots has not been large because of low surface run-off.

This installation is made possible by the cooperation of the following persons and agencies:

1. Mr. A. L. Sonderregger, who allows his private land to be used for the experiment.

2. Los Angeles Chamber of Commerce, Department of Conservation, which supplied funds for the experimental equipment.

3. Los Angeles County Forestry Department, which furnished labor and direction in burning slash.

4. San Dimas Water Company, which provides for the tending of the instruments.

5. Los Angeles National Forest Supervisor, who has furnished labor and direction in cleaning up the grounds.

It is proposed that this installation be continued and that the present burned plots be maintained in a bare condition. If it be possible to make arrangements for the installation of two additional plots to make up the standard of six, such a measure is proposed. The development of this installation, however, waits on the perfection of plans for the employment of San Dimas Canyon for a complete study, to be discussed under watershed studies.

North Fork installation. The North Fork installation was made in October, 1929, with four plots. Two additional plots were added in September, 1930, which now makes a standard installation of this type. One pair of the burned plots will be allowed to return to equilibrium by natural succession of vegetation and one pair of burned plots will be maintained in a bare condition throughout the life of the experiment.

Run-off records of all storms have been plotted to date. Thus far surface run-off from the burned plots has far exceeded that from covered plots. Equilibrium is therefore, not yet in sight.

The maintenance of this installation is made possible by the cooperation of Forest Supervisor M. A. Benedict and Ranger Madsen of the Sierra National Forest.

It is proposed that this installation be continued.

Variations in surface run-off from duplicate burned plots in this installation are discussed under the heading of "Development of Technique" in the general comments following this project statement. It is proposed that more detail of surface conditions be studied in burned plots to account if possible for the notable variations from duplicated conditions.

With this installation is included water relations equipment which will be referred to under that project.

Surface Run-off and Erosion Project Plans for 1931-32.

Two plans are presented, one on the present budget, and one on an increased budget of $30,000, as follows:

1. Under the present budget, it is proposed that all present installations be maintained except the Barranca. A new installation is proposed for a site near the Devil Canyon Nursery. This new installation will be equipped in part with the Barranca instruments and in part with new equipment including a multiple recorder. No other installation is contemplated. The other installations will be improved in means of collecting eroded material and in means of plotting vegetative succession.

2. Under a possible budget of $30,000. On this basis, in addition to the proposals under plan 1, it is proposed that five new complete installations be made, three at the North Fork center and two in southern California. The two southern California installations are proposed for upper San Dimas Canyon to form a part of the detailed study of that Canyon. The three new installations for the North Fork center are to include studies of the foothill belt where grazing damage to vegetation predominates over other influences and one new installation to be set up in the timber belt.

The proposals under plan 2 presuppose two yearlong men who will be located, during the field season, at the southern California and North Fork installations respectively.

Watershed Studies

Barranca watershed. The Barranca watershed study has been maintained and is reported on in detail under another section.

Duplicate watersheds. A project of prime importance for the next year is the selection of a suitable set of duplicate canyons in southern California, preferably in the San Dimas drainage. Tentative sites have already been inspected in the Santa Ana, Devil Canyon and San Dimas watersheds. This summer will be devoted largely to selection of the final areas and the preparation of working plan for the conduct of the study so that installation can be started before July 1, 1932. These studies are on the basis of commitments to Congress already made. They will involve the denudation by fire of one canyon and the maintenance of the other intact.

If the pair of canyons could be found in San Dimas, this would facilitate concentration of work so that it could be utilized as an important and needed center for Los Angeles County.

Erosion survey. A preliminary erosion survey of the southern portion of the San Joaquin Valley was made by Nelson and Lowdermilk and has been reported in manuscript. The statewide survey, especially as it is affected by grazing, is proposed for continuance. Such surveys are expected to indicate the type of grazing studies which are required to determine present damages as well as necessary regulation for improvement of range conditions.

San Dimas watershed. In line with the general program, San Dimas watershed is proposed as a location for the first installation to synthesize the factors within a watershed which influence the yield and character of flow of watersheds. San Dimas Canyon has been under close observation and study by H. S. Gilman, president of the San Dimas Water Company, for more than a decade. It is provided with one of the best flood control dams, which is fitted to measure the inflow of water. It is centrally located among water-yielding watersheds of southern California. And, finally, the watershed is provided with roads which make the rim and basin of the watershed accessible for installations. Geologically the basin represents the effects of normal erosion processes on two distinct formations which can be studied separately.

Accordingly it is recommended that San Dimas Canyon be designated as a watershed on which a complete series of studies be concentrated so

that results of each method may be interpreted in terms of other installations. Such studies will include surface run-off and erosion, plot installations, small duplicate watersheds, larger drainages representing type topography, and the entire watershed itself. The smaller watersheds will be subject to experimental control of vegetation. Likewise a full battery of meteorological and water-soil-plant relations equipment would be installed within the upper canyon basin.

The rate of development of this intensive watershed study will depend upon funds available, in the event of no increase, under plan 1. It is proposed that rain gages be established to measure the total catch of the watershed. With an increase, under plan 2, the recommended run-off plots and a duplicate watershed study are proposed.

Water-soil-plant Relations

Under the water-soil-plant relations project the two installations (North Fork and Devil Canyon) were maintained. The rain retention pans (18 in number) were found to be inadequately provided in 1929-30 with capacity in the collector cans. Consequently during the heaviest storms of over 6 inches the collector cans ran over. Records of retention were therefore incomplete for 1929-30. An additional collector can was added to each retention pan in the fall of 1930, which has remedied that defect. The data from these instruments show that:

1. Bare soil is more effective than litter in returning moisture to the air between storms.

2. Retention by bare soil is most satisfactorily measured by soil depths of 12 inches.

The lysiphytometers (6 in number) have demonstrated the feasibility of this new method of measuring volumetrically the loss of moisture from drained soil masses. It is therefore hoped that this instrument can be employed in a general study of water-soil-plant relations.

A change in the diameter of the instrument from 30. to 35.4 inches is proposed to make the surface area equal to 1000 square inches. This is to facilitate the measurement of water in units of cubic inches. A 500 cubic inch graduate was made which permits a satisfactory method of measurement of water volumetrically.

Soil sampling for moisture deficiency was carried out at intervals of one to two months at three localities.

Additional rain retention pans are proposed for installation at sites to represent a profile from the valley floor to the mountain summit in southern California and from the foothills to the forest belt in the Sierras. Lysiphytometers will be included as a part of the equipment at these installations. These installations will be equipped with atmometers and thermographs.

Under plan 1 of present appropriations it is proposed that one additional complete installation be made at Devil Canyon, and that the installation at North Fork be increased by 2 lysiphytometers and 4 rain retention pans.

Under plan 2 it is proposed that four complete installations be made, two at North Fork and two at Devil Canyon.

It is proposed to continue the sampling of soil for moisture deficiency in conjunction with the water-soil-plant relations installations. A technique has been developed by the Division of Agricultural Engineering which with modifications will apply to the conditions encountered on mountain slopes. With increased appropriations the increase of personnel will permit more detail in this investigation with consequently greater value.

It is further proposed to make the necessary installations in cooperation with the City of San Bernardino and the Division of Agricultural Engineering to measure the comparative yield of water flowing in an open channel of a canyon bottom filled with alders and other mesophytic vegetation, and of water piped through the same canyon.

General Comment

It will be seen that the program as approved by the Regional Investigative Committee of 1930 has been adhered to during the past year. The original program therefore, requires no radical changes excepting enlargement because of new appropriations.

All installations in use during the year of 1929 were maintained in operation. Improvements were made in a number of the water relation installations at Devil Canyon. It was possible to install only two new surface run-off erosion plots at the North Fork installation in the autumn of 1930, because of the small budget available for equipment.

With the aid of one technical assistant, it has been possible to keep the plotting of run-off records of the four installations up to date, in addition to the plotting of all back instrument records. There are on hand the detailed plottings of 60 separate storms. The graphs include the

following information for each storm and plot:

Intensity of rainfall by minutes

Cumulative rainfall

Rate of surface run-off plotted as cubic feet per second per acre by minute intervals.

Cumulative surface run-off as cubic feet per acre.

There remains the reduction of this mass of data to a formula basis, which cannot be exact because of variations in duplicated conditions which are discussed later.

A series of erosion studies in the road erosion tanks has been completed on the sample of Aiken soil series. This study has been reported in manuscript.

An erosion survey was made of the southern portion of San Joaquin Valley in cooperation with Assistant Regional Forester Nelson, and is reported in manuscript. This investigation forms a part of a statewide survey to be conducted as rapidly as can be practically carried out.

In addition to the routine of tending installations and the working up of data, a number of papers have been prepared for reading at conferences and for publication.

A field conference of engineers, foresters and ecologists similar to that held in September 1929 was held in October 1930. Plans were made for an attendance of 15 and 35 participated. Special consideration was given to the following points:

1. Overlap of rainy and growing seasons in southern California, which is important in the study of transpiration use of water by chaparral.

2. Field examination of cuts in "rim of the world" drive for evidences of watertables, supposed by some to parallel slope surfaces and supply chaparral roots with water throughout the growing season. No evidence of such movement of water as a sheet along bed rock was found; in fact all the evidence indicates otherwise, i. e., that fissuring, joint planes, etc., carry so much water deeper as to prevent any significant sheet movement parallel with ground surface.

3. Soil moisture sampling, as of major importance for the study of soil and plant water relations.

Findings of Special Interest

Surface run-off plots. Surface run-off between burned and covered plots has become nearly equalized on the Barranca plots in 4 years, and on the Panorama plots in 3 years. In fact, indications of reversals were found. There appears reason to believe that vigorous sprouting of evergreen vegetation may cause a greater retention in the recently burned plots than in the plots covered with mature forms of chaparral vegetation.

With the control of surface run-off followed a corresponding control of erosion, except in the creep of material on steep slopes. Creep continued to be more active on the recently burned plots than on the covered plots.

Erosion pavement. Data from the road erosion installation confirmed observations of the development of an erosion pavement on the Aiken soil. This soil contains small rock fragments which remain behind when the fines are washed away by thin sheet run-off, becoming consolidated at the surface in an "erosion pavement". Erosion pavement is a sensitive index of accelerated erosion. It is not as spectacular as gullies but may be an indicator of a more general loss of soil than gullying.

Relation of gradient to surface run-off. An unforeseen result in the road erosion studies was the uniformity of run-off coefficients from all slopes, with varying gradients of 5, 12, 17, and 23 percents. Gradient, that is, appeared to have no significant effect on the percolation rate for bare surfaces. The amount of eroded material varied, however, directly as the gradient. This may indicate that the rate of run-off was affected by slope, since without differences in total quantity of surface run-off, it would still be possible that velocity and hence transporting power varied with slope gradient. This installation is not equipped to measure automatically the rate of run-off which presents the answer to the question just raised.

Experimental variations in surface run-off. Differences in surface run-off between covered and freshly burned plots are often incomparable by reason of no run-off covered plots. Also, differences between duplicate burned plots are greater than probable errors, and indicate that unknown factors are operative in the results. Such factors may be either variable periods of rain intensities which are in excess of the percolating rate of the underlying soil, or small surface irregularities which affect the amount of channeling by run-off.

Developments in experimental technique. The variations in duplicate burned plots just referred to, present some problems in respect to the objectives of experimentation. These differences may be as much as twice the lesser value, which is far beyond the range of probable error due to chance. Such differences in surface run-off from theoretically similar surface conditions indicate variations in sampling under the conditions of field experimentation.

One of two alternatives must be accepted. Either this range of variations must be accepted as unavoidable in field experimentation of this sort; or further refinements in experimentation must be made. The first alternative suffices to discover major factors but is unsatisfactory for scientific work because it leaves unexplained the operation of obscure but possibly important factors. For these reasons the second alternative appears the more desirable.

The first step toward the elimination of unknown variables responsible for the differences referred to above is to single out probable variables for control. Varying intensities and duration of rain may be one. Surface run-off cannot occur, over a pervious medium, without an intensity of rain in excess of the percolating capacity of the soil under the given conditions. Natural rain falls very irregularly. If a natural rain intensity sufficient to cause run-off lasts only long enough for surface run-off to flow one-half the length of the experimental plot, then run-off will be registered from only one-half the plot. A wide range of possibilities is thus involved in varying durations of effective rain intensities. If effective rain intensities were to last for an hour or longer, variations of this nature would largely disappear. Artificial rain by sprinkling is suggested as a means for eliminating this variable.

Only slight surface features are needed to effect wide differences in the accumulation of surface flow into channels. The more surface run-off becomes channeled the more rapidly it flows and escapes from a given area. The control of channeling may involve artificial treatment of plot surfaces. It is desirable to clarify the part which mechanical resistance to flow may play in run-off control.

Experience with the surface run-off and erosion installations during the past four years indicates the desirability of focusing a number of lines of study upon a few study areas, rather than the increase in number of installations. It is especially desired that all the methods of field experimentation, including plots, small watersheds, water relations experimentation, and soil sampling be carried out on the same watershed, fitted with a flood control dam and facilities for measuring both the total run-off and its rate. Such conditions will make possible the interpretation of results of one method of experimentation in terms of others.

San Dimas Canyon in Los Angeles County, offers such a possibility. Concentration of studies in San Dimas Canyon is proposed for approval as the next major step in the development of field experimentation in this project.

How much water does canyon bottom vegetation use? Plans are under way to carry out a cooperative experiment to determine how much water is lost by evaporation and transpiration from a stream flowing through typical canyon bottom vegetation, by measuring its flow at the end of such a section in comparison with that secured by piping the stream flow out of the canyon at the head of the section under study.

Natural areas as required for influences and erosion studies. It has become increasingly clear in the progress of these studies that it is needful to know the normal rates of erosion and run-off from slopes of catchment areas. As has been shown elsewhere, it is necessary to recognize a geologic norm of erosion, which represents the normal function of erosional potentials upon given geological structure with soil development under a mantle of vegetation, responsive to climate through time. Without some measure of this norm it can not be known to what extent disturbance of the area by man and his agencies will accelerate erosion. Consequently, for a basis of comparison of normal and accelerated phases of both run-off and erosion, it is essential to have areas covered with natural vegetation. In the absence of virgin areas, the setting aside of areas under complete protection from outside disturbance is the next possible and urgent measure, in the hope that such exclosures will favor the return of vegetation in response to existing climate, as far as may be possible on a given state of a soil which has been subjected to the effects of accelerated erosion.

To serve the objects of studies of run-off and erosion, the acreage of natural areas exclosures should be large enough to create local climatic conditions. Areas of 500 to 1000 acrea are therefore considered the minimum. Likewise, it is essential that drainage units within the exclosure be complete, so that drainage channels will be a complete reflection of a natural cover on the catchment area. Such areas are especially needed in all the overgrazed sections of the state and throughout the foothill belt.

Action by Committee

The Committee approved in full the program proposed. The discussion stressed the importance of the establishment of well paired experimental watersheds as the most urgent next step in this project.

The study by Professors Shaw and Bodman of the University of California Division of Soil Technology, presented at this time, of the

basic volcanic soils of the mountain region of Bogard and Harvey Valley, and their indicated desire to extend the study to acid granitic mountain and forest soils, if necessary additional funds and personnel for such study could be secured, were received with approval as of great importance to forestry research in both silvicultural and forest influence lines.

Barranca Watershed Study

The accumulation of rainfall records from seven gages on this area, observation of run-off and erosion, and charting of vegetational changes on permanent quadrats on this 44-acre watershed have been continued during the past year.

Rainfall

The records of 37 storms caught during 3 rain seasons by the 7 gages on the area have been compiled. The attempt to draw isohyetals for each storm, in an effort to determine more exactly the total precipitation on the watershed, was abandoned on account of the lack of consistent relationship between altitude and amount of rainfall. The assignment to each gage of a definite territory of which its records could be regarded as representative was also rejected as a trustworthy method. Curves were found too erratic and confusing for clear presentation, but bar diagrams proved useful in comparing standard deviations and quantitative departures from the average for each gage. The following table presents the three year's record of precipitation on the watershed, showing the total amounts recorded by each gage:

Rainfall on Barranca Watershed

Rain season of		1928	1929	1930		3-Year normal for each gage
Number of storms		16	12	9		
Gage	Altitude	Actual amounts in inches				
1 d	1935	18.44	19.89	10.99+	.26	16.53
2	2277	16.63	15.57	9.46+	.22	13.96
o3 m	2372	18.07	18.10	10.26+	.24	15.59
o4	2580	16.04	13.84	9.13+	.20	13.67
o5 a	2952	20.67	20.27	9.83+	.23	17.00
o6	2605	18.66	16.44	9.58+	.22	14.97
7	2180	16.99	16.30	10.39+	.24	14.64
Averages		17.93	17.20	(1) (2) 10.01+-1.61 (3) 11.62		15.11

(1) 1930 incomplete - lacking one storm in February.

(2) Average of the February storm computed in relation to records of a nearby gage.

(3) Corrected average of 10 storms.

Gage 1 is on the dam at the canyon mouth; 3 on a median ridge near the center of the watershed; 5 on the gentle summit slope.

This table reveals a consistency in the relationship of total annual catch of the various gages to one another. With respect to individual storms, however, the only apparent consistencies are the uniformly high catchment of gage 5 on the summit plateau, and the low catchment of gage 4 on a southeasterly slope only 330 feet lower. Gages 1, 2, and 7 at lower elevations than 4 show higher catchments in most storms.

It is difficult, from the results of these three years, to say whether seven gages are either adequate or more than adequate to secure reasonably accurate record of precipitation on this 44-acre watershed. If economy required reduction of the number of gages the standard deviations would indicate the selection of gages 3, 4, 5, and 6 as representing the consistent low recorder 4, the consistent high recorder 5, and the two which approximate most closely the 3-year general average, namely gages 3 and 6. By mathematical methods the 3-year normal for the entire watershed is indicated as 15.11 inches. Beyond this it seems useless at present to manipulate the data.

Run-off and Erosion

The precipitation of 1930 was not only considerably below normal in total amount but brought no storms of intensity sufficient to produce measurable run-off in the 12-inch Parshall flume. Six small flows were recorded by the small flume which was installed last year below the large one for this purpose, but these were short flash flows the largest of which touched a rate of approximately .16 second feet. Altogether, the season of 1930 did not constitute an adequate test of the combined flume method of measurement.

In consequence of this light precipitation and run-off the amount of eroded material brought into the reservoir was likewise insignificant. This was estimated at less than 100 cubic feet and consisted entirely of material cut from dry slides in the channel close to the reservoir.

Developments during the present season of 1931 are proving important. Several storms of sharp intensity have resulted in run-off strong enough to bring down considerable quantities of the dry slide material which has accumulated in the channels of the watershed during the past two years. Observation of the flumes in action has revealed the following points:

1. The recorders are not dependably automatic. Even though the clocks may be working and the pens tracing smoothly before a storm, the unusual action caused by the rising water may itself cause a loss of record by lifting the pens from contact with the paper.

2. Subsiding waters following the first surge of run-off may leave the flumes, and particularly the tubes leading to still-wells, so clogged with debris that subsequent records may be either lost altogether or vitiated.

3. Large rock fragments, even though not too large to pass through, may accumulate with sand in the flume and thus check-dam the finer debris so effectively as to fill the entire structure, permitting subsequent run-off to by-pass and go unrecorded.

All of these troubles have occurred during the 1931 season. They point unequivocally to the necessity of constant personal attention to the instruments during action. Most serious is the third difficulty which challenges the success of the flume method of measuring the type of wild flood, bulked by large boulders, which follows high intensity rains on newly burned watersheds. Three possible methods of providing such flows suggest themselves:

1. Installation of a Parshall flume in the canyon mouth large enough to accomodate the maximum possible flood, securing the needed capacity by width rather than depth in the flume.

2. Removal of the larger boulders and debris by means of check dams prior to measurement of the flow.

3. Collection of the flow in an impermeable reservoir, permitting determination of rate of flow by computation from capacity curve and height gage records of the reservoir. (This method was used in 1928 when filling of the original weir basin negatived the value of the weir records.)

All of these methods are beset with complexities or disadvantages in the way of expense which would have to be balanced in application to the circumstances of any contemplated watershed study. The indications are that a thoroughgoing study on a large scale of two pairs of comparable watersheds, which involves the denudation of one pair, will be a very costly project under the conditions of climate and terrain in southern California.

Succession Studies in Chaparral

The study of the reaction of the chaparral types after fire is an essential step in the general problem of chaparral influence upon the water cycle and erosion. Two methods of attack have been developed: (1) detailed study of permanent quadrats, the vegetation of which is charted annually; (2) general observation of larger areas supported by repeat photographs of

typical conditions from fixed camera points.

Quadrats. The observation of vegetative succession in chaparral following fire was begun in 1927 by the establishment of 36 milacre quadrats on the Barranca Burn of 1925. These quadrats are yielding fundamental information on the life histories of a number of shrub and herbaceous species in addition to securing for the first time a quantitative record of the rise and decline of herbaceous and graminaceous vegetation which is so striking a feature of chaparral burns.

With respect to shrubs the most significant data being accumulated concern the habits of reproduction by sprouts or seedlings, the vigor of reproduction as represented by abundance and rate of growth, and the soil protective value as reflected in soil fixation, litter development, and cover density of the different species.

Regarding herbs and grasses, the most significant finding has been the effect of these plants, which are individually weak in structure and of short life-span, in developing under favorable conditions an important control of run-off and erosion at the point of origin. The growth of small plants in incipient gullies, the development of "litter-mats" or small check-dams through the anchorage of wind-blown dead stems by annual grasses, the protection of inter-shrub soil surfaces by herbaceous growth - all such small-scale vegetative processes in burned areas build up a cumulative effect which has greater importance than appears possible from casual observation.

General Observation and Photographic Record

This method, in which the data accumulates in the form of repeat photographs with detailed explanatory notes, makes possible a wide range of observation to test the extent of processes revealed in the quadrat study. As applied in portions of the Cajon burn of 1928 on the San Bernardino Forest and the Liebre burn of 1927 on the Angeles, the method in addition to verifying the quadrat results, has brought out strikingly the role of annual and perennial vegetation in fixing loose slopes until seedlings and sprouts of shrubby species attain sufficient size to make the fixation permanent. A few of these "plant controls" may be mentioned.

1. The lush growth of Helianthus gracilis on loose talus slides and gully banks.

2. The appearance of Ceanothus crassifolius seedlings at a density of more than 100,000 per acre to anchor unstable slopes of decomposed granite against "dry erosion".

3. Control of similar slopes and of incipient gullies by the remarkable chilicothe vine or bigroot, Echinocystis macrocarpa.

4. Capacity of Convolvulus, Phacelia, and Stephanomeria to check gullies and hold loose fills in shallow stream heads until shrub species have re-established control.

The degree of effectiveness of these processes is dependent upon a number of variable factors but chiefly on the intensity of precipitation following fire. A series of light rains will usually start a vigorous growth of the lesser plants; torrential downpours may result in rapid run-off and erosion of destructive proportions before vegetative control is established or against which the herbaceous control here described is quite ineffective. Obviously a wide and unpredictable interplay of factors and results is possible. Continued observation and recording of the factors and processes involved is essential to better understanding of the results.

From the standpoint of practical value the herbaceous influence on water-flow and erosion appears, under certain conditions, to be of considerable importance in maintaining the effectiveness of pipe lines and check dams now commonly employed in water gathering and flood control. It is not implied that man can do much to encourage the process, except perhaps to increase all means of protection from fire. But, in view of our present admission of the importance of chaparral cover in regulating run-off and controlling the quality of waters yielded by southern California watersheds, it behooves us to examine critically every phase in the development of that cover.

For the future it is proposed that the ecology of the chaparral be recognized as an individual project of major importance and that the work be gradually enlarged. In this program the study of succession after fire offers one avenue of approach already entered which should be followed farther. During the coming year it is planned to make a limited extension of the quadrat method, and to push the photographic-observational method farther afield. The results to date have been recently presented in two brief papers before meetings at Stanford and University of California at Los Angeles and are planned for publication, probably in Ecology.

Meteorological Observations.

Inasmuch as the measurement of weather conditions is an essential part of the study of site factors they may be discussed at this point. Records of precipitation, wind movement, temperatures of air and soil, and relative humidity have been taken since 1927 at Devil Canyon Branch which may be regarded as a key station typical of the south front of the San Bernardino Mountains. This year it is planned to add evaporation instru-

ments to the existing station.

In November 1928, at the instigation of Dr. F. E. Clements of the Carnegie Institution, we established two observation stations on the Santa Barbara Forest, one at the summit of the Santa Ynez Range and one in Santa Ynez Valley north of the range. These stations, combined with one on the south side of the range maintained by the Blakslee Botanic Garden, yield a cross-section of conditions in this region, which is finding immediate use in a cooperative study of transpiration in the costal dunes, the piedmont slope and the crest being conducted by Dr. Clements. Precipitation records for 1929 and 1930 have been compiled and yield the following interesting summaries:

	Total Precipitation in Inches	
	1929	1930
Summit (Knapp Lodge)	19.61	15.76
North Valley (S.Ynez R.S.)	11.38	12.02+

The 1930 total for Santa Ynez Ranger Station is incomplete, lacking records for May during which time the summit station recorded a fall of 1.92 inches.

Erosion Control

Circumstances in connection with the construction of the new high-gear road up Waterman Canyon in the San Bernardino Forest gave opportunity for the installation of a modest experiment in methods of controlling erosion on new road fills. The scarring of the mountain front by large areas of raw cut and fill was inevitable in the construction of a high standard road through such steep country, but it proved a painful surprise to many people who had been strong advocates of the road. In addition to this scenic damage, the loose overcast material was eroded to an extent equal to that common on many burned areas and caused heavy damage to canyon bottom vegetation and to the newly built water spreading grounds of the San Bernardino City Water Department below the mouth of Waterman Canyon. It was this latter experience that prompted the installation of at least a preliminary experiment to feel a way into the problem.

The southern California Division Engineer of the California Highway Commission, was consulted and agreed to cooperate in the experiment. The installation was made in November on a small fill near the lower end of the new road. The fill was divided into six vertical sections, each 20 feet wide, extending to the foot of the filled slope to variable lengths from 40 to 75 feet. Three sections were variously contour-trenched and seeded with a view to control by quick revegetation, one section was sprayed with hot road-oil by the Highway Department, and two were left untreated as checks

The original plan of control by these methods contemplated their initiation at the end of summer but before the first winter rain, the aim being to work upon a uniformly settled slope before it had been cut by gullies. Unfortunately this plan could not be realized; rains in October and early November produced gullies which had to be eliminated by hand methods prior to the initiation of the experiment.

Examinations made in December and February show encouraging results and already indicate possible improvements in method. Most effective treatments were the seeded-wicker-barrier and the oil, but the plots seeded in trenches unsupported by wicker barriers were also reasonably effective. The two checks showed interesting differences in erosion; the first in soil similar to the treated plots was profusely gullied; but the second, in more compacted soil filled with sharp rock fragments, had no deep gullies, indicating that control need not be applied to such soils.

Seed used in the experiment included the following:

1. Barley, for its quick germination and growth in the autumn and its nursing influence on other species.

2. White clover, for the surface soil-binding qualities of its fibrous roots and for its nitrogen-fixing powers.

3. Wild alfalfa (Deer-weed), similar to white clover but more so.

4. Wild morning glory, for the soil-binding qualities of its hummock habit and the inter-twining value of its long creeping stems.

5. Wild sunflower and Tree tobacco, for their thrifty growth in raw unweathered soils and the anchoring effect of their deep roots.

6. Ceanothus crassifolius, a shrub, for its ability to establish itself from seed in raw unstable soils. (Upon the development of shrubs depends the permanence of the vegetative method of control.)

7. Miscellaneous species of perennial wildflowers to increase the chance of securing the dense vegetative barrier in each contour furrow upon which the theory of the method is based. Incidentally to lend interest to the roadside cover with a minimum of effort.

Within ten days after the start of the experiment the barley had appeared and grew rapidly thereafter to a height of 8 inches by February 22. White clover appeared in three weeks but has remained insignificant in size. Sunflower seedlings were abundant on February 22, but no other species could be identified at that time.

The use of cuttings of trees and shrubs offers another possible method of revegetating the road slopes. Cuttings of willow, elderberry, alder, coffee berry, and oak were used to peg down the wicker barriers which in turn were made of scrub-oak sprouts. On February 22, the willow and elder cuttings showed 100% sprouting and many of the sprouts were 6 to 8 inches long. None of the other species had sprouted.

On the basis of this experience it is recommended that this study be continued on at least the same scale during the coming year. With adequate preparation a repetition of the installation should prove more effective.

With regard to the need for such a study in connection with this particular road the repeated and extensive damage done to the water spreading works and to the bed of Cold Creek Canyon appear to be sufficient justification. In addition, aesthetic considerations must also be regarded as carrying considerable weight. The fact that the construction of this road, one of the most costly in the state, has been forced by the large volume of recreational traffic is itself a recognition of the weight of such considerations. Inasmuch as the road lies wholly within a national forest the inference follows that the Forest Service at least shares the responsibility of minimizing the damage. Whether or not the study of control measures is within the sphere of the Experiment Station is perhaps debatable and appears to be a proper matter for decision by the Investigative Committee. Because of its close connection with our interest in the general problem of vegetative influence on erosion, and because of the emergency nature of the case, the Station undertook to make the modest beginning here described. The responsibility of the Highway Department is obvious and hence the project was regarded from the outset as a cooperative one. Future work, if any, should be continued on this basis.

In conclusion, it is submitted that measures for the prevention and control of erosion on new roads have rarely been given adequate attention in the past. Such measures are especially needed on mountain roads, and, since most forest roads are of that type, it seems fitting that the Forest Service take the initiative in securing recognition of this matter. Adequate measures for erosion prevention on all new or reconstruction road projects should be provided for in advance by special clauses in the specifications and contracts. Mere drainage is not enough; something must be

done about large fills, overcast and cut slopes, and occasionally about stretches of abandoned road. Methods need not be discussed at this time since they are in large part still to be worked out, but it is believed recognition should be given to the principle that adequate erosion prevention is an essential operation of good road construction and a legitimate charge against the cost of construction. It seems only reasonable that a project costing upwards of $100,000 per mile could easily bear an additional burden of $5,000 or even $10,000 more per mile to minimize the necessary havoc of construction.

Action by Committee

Report approved.

Fire Studies

The fall and winter of 1930 were devoted practically entirely to field and office work in the determination of the detection needs and possibilities of the Sacramento Canyon Unit of the Shasta Experimental Fire Forest. At the same time effort was directed toward development of standard methods and technique for making visibility studies.

Shasta Fire Control Project

During this period seven new points, appearing to have promise, were occupied and visibility maps prepared. Two points previously mapped by topographers were occupied and visibility mapping checked. Visibility was satisfactorily mapped and it was decided to use all maps prepared in 1929 and 1930 by topographers of the Branch of Engineering and the Shasta Administrative force.

In stormy weather time was spent in making overlays of visibility maps already prepared to be used in comparisons of the desirability of present and proposed lookout points. The visibility from two desirable points was plotted by the profile method on the topographic base which is available to secure a basis for comparison of the field method with the profile method. The two methods differed but slightly in the delineation of visible areas, with the result that it was decided that the profile method would be used later in the season when it was impracticable to occupy points.

Profile visibility maps were made of four additional points and numerous check profiles were run to determine whether a specific point would look into a definite blind area.

In all there are now available visibility maps from twenty-six points. From these points will be chosen the most advantageous and practical lookouts which afford satisfactory detection for that portion of the Experimental Forest in the Sacramento Canyon.

The bulk of the winter months has been spent in securing and recording on overlays the results of various combinations of lookouts, with a view to effectively covering risk and hazard areas with the minimum number of lookouts practicable. On this will rest the final decision as to the best lookout system.

In the making of field visibility maps the most prolific source of error is the delineation of the lower limits of a visible area in looking over an intervening ridge, when there is no recognizable topographic feature near this lower limit by which to gauge. Study was made of several methods of determining mathematically the elevation of this limit. As a result

an alignment chart has been devised which gives the elevation with a vertical error of less than a contour interval and a negligible horizontal error. This chart appears at the present time to be the most satisfactory method of determining this lower limit with any degree of accuracy.

In connection with data on detection, being compiled for the proposed bulletin, "Detection Needs", by Kotok and Show, additional detailed information was collected on the performance of individual lookouts of the Shasta National Forest. This will be of value in determining the relative effectiveness of these lookout points from the standpoint of topography and performance. At the same time the data gathered have given useful figures as to the effectiveness of motor patrol, showing that for the past three yea motor patrolmen have made first discoveries of some 25% of the fires in the Sacramento Canyon. These data will also have a bearing on the study of radi of vision, on which some work is being done.

Lookout check report forms, inaugurated on the Shasta Forest in 1930, were of considerable use in checking lookout performance. If kept up to date by the local forest force these forms will serve the purpose of a cu rent check of lookout performance as well as a ready source of statistical data on detection efficiency.

The fire suppression crew forms also inaugurated in 1930 will give informative and useful data when analysis is completed.

In connection with analyses made of efficiency, etc., the prevention objectives covered on page 70 of the 1930 Investigative Program will not be overlooked. Additional preventive measures will also be sought.

The following administrative projects for intensifying present lines of endeavor have been instituted in line with the objectives of the Shasta Fire Control Experiment and in pursuance of the program set up in the 1930 Investigative Program.

1. Installation of a full time suppression crew of 5 men at Castella with a fully equipped truck.

2. Securing of a metallic trunk telephone circuit in the Sacramento Canyon.

3. Construction of the Round Mountain - White Horse - Wiley Ranch telephone line.

4. Connection of newly occupied stations by emergency telephone lines. Construction of standard lines withheld until final selection of stations is made.

5. Increase of motor patrol to two day-patrols and one night-patrol. Prevention work carried out by patrol men. Government owned patrol cars furnished.

6. Strengthening the detection system in the Sacramento Canyon by placement of two additional lookouts.

7. Completion of the transportation study for the Shasta Forest. Analysis remains to be done as discussed under plans.

Radius of Vision

Collection of data was started in 1926 and carried through 1927 by the Santa Barbara forest force to be used in determination of radius of vision for a given lookout. In order to determine the kind of data to be required in future recording of observations, the 1926 and 1927 figures were worked up in the form of graphs and curves. The limitations and inadequacies of the material collected were thus recognized and a more adequate form will be devised. The Santa Barbara plans to record the data according to an approved form during the coming field season. It is evident that this study will require collection of data for several years before any definite conclusions can be drawn as to the effect of humidity, wind direction and velocity, position of the sun (time of day), and degree of haze or smoke present on the radius of vision in different quadrants for given lookouts.

Fire Damage Studies

The series of plots established in the past to study the effects of fire on different tree species and age classes will be continued. The conclusions reached in 1925 have not been changed to any appreciable extent by the data secured in subsequent examinations. The results up to 1925 were published in Department Bulletin No. 1294, "Role of Fire in the California Pine Forests". The examinations of existing plots will be continued. No installation of new plots is contemplated for the coming season.

The Kern Ridge Damage Study area on the California National Forest has been examined annually and observations recorded on progress of restocking of the burned area both by brush and timber species.

Statistical Studies will be continued under the personal direction of Kotok. A bulletin on hour control was published during the fall of 1930, by Show and Kotok, which gave the results of statistical studies of fires occurring during the last ten-year period. The bulletin on Detection Needs, before mentioned, is in process of preparation and will be published in 1931 The coding and punching for all fires up through 1930 has been completed, together with some tabulations.

Plans for 1931

Shasta Fire Control Project

The Annual Investigative Program for 1930 states the objectives, subprojects contemplated and setup of the responsibilities of both the administrative and research organizations in the carrying out of the program.

For the season of 1931 the following plans will be carried out for the Shasta Fire Control Project.

Visibility and Detection.

1. The present visibility material will be assembled in usable form before the beginning of the field season. The selection of the combination of lookout points for the best coverage in the Sacramento Canyon will be made. Costs of improvements necessary to man these points will be estimated (roads, trails, telephone lines, buildings, water systems). The coverage and costs will be correlated and detection planned as intensively as the law of diminishing returns will allow.

2. Further field visibility maps will be prepared in the region in the northern portion of the Sacramento Ranger District and in the McCloud and Pit districts. The best combination from a standpoint of risk, hazard, and cost of construction and maintenance will be selected for these portions of the Experimental Fire Forest, as was done in the Sacramento Canyon.

3. A study is planned to determine the contribution which photographs make as an aid in the construction of visibility maps and in actual use by lookouts in determining the location of fires. This work will be correlated with work done in Region 6 by Osborne, in order to avoid duplication of effort and to secure the advantage of technique already developed.

4. Radius of Visibility or Range of Visibility work is planned for the determination of the maximum effective distance within which we may expect a lookout to discover a fire when in the A stage, B stage. In this connection it will be necessary to utilize an Experiment Station Staff member as an observer, with the object of determining, for fires in the area of visibility:

   a. How long a fire must burn in given cover types under various atmospheric conditions before it can be discovered.

b. How big must a fire be to be discovered.

c. The type and power of binoculars which will aid most in detection of fires.

Experimentation to determine the value of tinted glasses as an aid to the eye in distinguishing between smoke and fog and in reducing the effects of haze or smoke. The development which has been reached in photographic color screens seems to give this much promise.

Another problem is the development of a simple and effective smudge pot which will allow characteristic test smokes to be put up at any time or place with safety.

A form will be developed and put into use to record data for the study of radius of effective vision and also for the study of the effect of haze and smoke on visibility. The observations will also serve as an administrative measure toward keeping lookouts alert.

A series of standard classifications for degree of haze or smokiness will be developed. These classifications will then be defined and translated into simple terms which can be used in determining, describing, and recording haze or smoke conditions at different periods of the day, on the above mentioned form. A bibliography has been prepared on study of various phases of visibility already made by physicists.

Detection Improvements.

Experiments will be made in trying out different types of lookout boards in an effort to develop a board that is simple, that will not confuse the lookout, and that is fool proof (cannot get out of orientation when moved to miss corner posts, etc.).

Investigations will be made into the field of portable towers whic are light, easily set up and dismantled, for the purpose of determining heights of towers required for a given set of conditions.

Check and Analysis of Transportation Study

The data secured in the Regional transportation study for the Shas National Forest will be reviewed and analyzed to determine the priority of the proposed projects and those which should be recommended for immediate co struction. This work contemplates checking the proposed projects in the lig of fire business risk and cover type hazard. Thus a list of projects by pri ities will be recommended for the guidance of the Regional Forester in the a proval of construction projects.

Forms

As a means of securing more accurate or detailed information in certain phases of fire control, existing special forms will be reviewed and revised to furnish the data now thought necessary. Such additional forms as appear really necessary will be devised to supply information in the form, sequence, and detail essential for proposed studies.

Appraisal of Personnel and Action.

Appraisal of the effectiveness, proficiency, and function of the various elements of the fire organization of the Shasta Experimental Forest is planned through members of the Experiment Station staff.

Use of Water

A definite plan should be developed for water use in fire suppression, on the basis of recorded observations, embracing such items as -

1. Distance from base that use of trucks is practical.

2. Types and capacities of trucks as affected by road conditions and water supply.

3. Water development and storage facilities for refilling tank trucks.

The technique of the use of water will be observed and appraised with the idea of determining facts as to amount, methods of application, and time in relation to effectiveness.

Experimental Fire Equipment.

Experiment Station fire project personnel will take part in the testing and experimental use of new equipment, cooperating with the administrative branches in giving it a fair trial and making accurate observations as to its use and effectiveness.

Chemicals

The most important phase in the line of chemicals is that of chemicals which will kill brush sprouts and can be used in maintenance work on roads, motorways, and firebreaks. Some work is being done along this line by other agencies. The part of the Experiment Station at the present will consist of taking cognizance of the most promising chemicals, aiding in testing and keeping records of results.

Fire Lines and Firebreaks in the Los Angeles Area

Work will be started on this project by the collection of historical data as to date of construction, location, mileage, type of construction and costs. At the same time information will be secured as to the actual use of fire lines for the control of fires and as an aid to movement of men and supplies on going fires. The investment represented by costs of construction and maintenance will then be compared with the investment represented by other protection measures.

Critical Fire Analyses

If time is available before the field season, a critical fire analysis for the Eldorado and Lassen National Forests will be undertaken by the Regional Office. Members of the Experiment Station will aid in this analysis which will weigh the effectiveness of the fire organization of the above forests. Special attention will be paid to the developments and changed conditions of the past ten years in as far as they influence the effectiveness of the organization in the control of fires.

Liaison Committee Meeting

The Forester will appoint an Inter-Regional committee of Forest Officers who will meet in Region 5 to discuss the Shasta Fire Experiment. The date for the meeting is tentatively set for the latter part of May.

Action by Committee

Report approved.

Discussion of next year's work centered on the necessity of adding work in the South to that on the Shasta. It was agreed that until additional funds could be secured, such diversion should be held to the minimum but that some diversion was probably necessary in order to satisfy southern pressure. There was also a discussion of the matter of applying experimental work in fire to the direct education of administrative forces by having them see the work in progress; also, the possibility of other extension effort within the Forest Service in making results available for administrative use.

Office of Forest Products

Production and Utilization Studies

Woods and Mill Study. All data from the Pickering woods and mill study pertaining to woods and mill operations, depreciation and surfacing were transferred to punch cards for machine sorting and tabulation. The Division of Forestry of the University did all work on the cost studies from stump to pond. The Office of Products computed the mill, depreciation, and planer studies. Mill cards were punched at Madison and summaries were started there. Later the cards were returned to Berkeley for tabulation on the University machine, which was done because the machine computing at the Laboratory was difficult for both parties, from the standpoint of correction of errors at such long range, and because they could not give enough time to our work to insure completion of a preliminary report which was wanted by the Regional Office of Forest Management before the beginning of the 1931 logging season. Cooperative funds were raised by lumbermen to pay for the use of the University tabulating machine and speed up the work by putting on extra computers.

By using shortcut methods, such as curving values instead of grades a preliminary report was sent to the special "White Fir Committee" members on February 21. There was not time to draw any general summary of conclusion - merely the facts were presented. The report showed costs, values and margins for log grades and tree classes, cut by lumber grades as tallied, various summaries of unit cost information, complete data on the stand and cutting systems and comparative margins from the different marking methods.

The stand was exceptionally heavy and of high quality in the pines. The original stand 12" and over was 59,284 feet B.M. per acre on the marked area of 73.7 acres.

A few of the tentative results (subject to some change after values have been re-computed on a curved lumber grade basis) are as follows:

Logs which do not pay from the economic standpoint, 1929 price basis:

W.Y.P.	Grade	2 logs	14" and under
	"	3 logs	13" and under
	"	4 logs	17" and under
S.P.	Grade	2 logs	14" and under
	"	3 logs	14" and under
	"	4 logs	16" and under
W.F.	Grade	1 logs	20" and under
	"	2 logs	21" and under
	"	3 logs	23" and under
I.C.	Grade	2 logs	13" and under
	"	3 logs	15" and under

It costs over twice as much to log and mill 8" fir logs as 14" logs, and twice as much for 10" logs as for 38" logs, exclusive of fixed costs per acre, felling, limbing, and brush disposal. Assuming a brush disposal and snag felling cost of 60¢ per M feet, a stumpage charge of 50¢, a fixed acre cost of $1.75 per M and a felling and limbing cost of 65¢ per M, the only white fir logs yielding a positive margin for profit and risk were grade 1 logs 30" and over and grade 2 logs 32" and over. The largest grade 3 log tallied was 40" in diameter and this size showed net loss of 38¢ per M feet, although all over 24" paid something toward the fixed costs, felling, etc.

Trees. There was a difference in the values of different classes of trees of the same D.B.H. but the probability of error, due to the small samplings of certain D.B.H.-tree class subdivisions is doubtless greater than the value differences shown in the tables. In sugar pine, for example, some Class 2 trees were worth more than Class 1 trees of the same D.B.H., while in yellow pine and white fir Class 1 trees were more valuable.

Trees which did not pay from the economic standpoint

W.Y.P.	Class 1,	19" D.B.H. and under
	" 2,	21" " " " " "
	" 7,	24" " " " " "
S. P.	Class 1,	24" D.B.H. and under
	" 2,	23" " " " " "
	" 4,	24" " " " " "
	" 6,	25" " " " " "
	" 7,	24" " " " " "
W.F.	Class 1,	31" D.B.H. and under
	" 2,	36" " " " " "
	" 3,	34" " " " " "
	" 4,	42" " " " " "
	" 5,	37" " " " " "
	" 6,	(25" largest tree; none paid)
	" 7,	(29" largest tree; none paid)

White fir trees, Forest Service marking, all classes combined, 40" D.B.H. gave a zero margin, all under this size, negative margins ranging from $.28 on 38" D.B.H. to $27.91 on 14" D.B.H.

All of the above economic D.B.H. limits are based on margins betwe values and operating costs exclusive of fixed costs per acre, slash disposal and stumpage. The two latter, which are fixed costs per M feet, will raise the economic limit in fir to 46" D.B.H.

Comparison of Cutting Systems

Cutting System	Margin per M ft. available for stumpage, brush disposal, profit and interest, average all species
Heavy Cut	$ 12.45
Leave all fir and cedar; also all pine 16" and under	20.27
Forest Service	13.10
Economic Selection	21.93

The total operating loss on white fir, as logged under Forest Service requirements, was about $2.66 per M, including 50¢ stumpage. The loss on cedar was $1.24 per M feet.

Plans. Before the results can be published, the data must be worked out on the basis of curved lumber grades. It will be of very doubtful value, considering the vast amount of work involved, to grade-curve each tree class. The samples are insufficient and even though the most careful statistical methods were to be used, the results would have only a limited application. The trees from a stand less dense than the Stanislaus sample plot might show an appreciable difference in values.

Enough samples have been examined from the Pickering data to show that log grades, using a somewhat finer classification than the present logging engineers rules, are better criteria of values than tree class. The accumulating results seem to indicate a prospect that the "building-up" system of correlating standing tree classifications and mill values on the basis of log grades involved may be as reliable method for conducting future woods and mill studies in the California region and will certainly be much cheaper, than that of carrying the record of identical logs clear through from woods to mill. If so, it would have many recommendations. Woods and mill studies could be conducted in the same operation; many of the logs tallied at the mill would be the same as those scaled and graded in the woods and the rest, if from the same general area, would be similar in character; the woods data would show, for all of the samples within a given D.B.H. and tree class the total number of logs by diameter, length, grade, and scale, the mill data would show values for every class of logs coming from the same area, and the value of a given tree class would then become merely a matter of weighted averages. The work could be carried out with small crews of experienced men; a greater range of woods conditions could be covered because the crews would not be tied down to one sample plot; better mill data could be obtained by a smaller crew, working only in the day time (night shift work such as that on the Pickering study should never again be considered); the cooperating company's operations would not be disturbed; log graders and scalers could do better work because it would be unnecessary to decipher woods numbers.

It is recommended that a study in the east side type be made as soon as the Stanislaus study report is finished and the degrade and stain studies are published. Woods work can begin possibly in the fall of 1932 (tree classification, selection of areas, general planning of study.) It remains to be decided whether one large study shall be carried on at one mill or two or three smaller studies at two or three different mills. The latter would appear more dependable for regional application.

At least one more study should be made in the west side Sierra region.

Lumber Depreciation Study The lumber depreciation data from the Stanislaus mill study are partially worked into shape for publication. Information on white fir depreciation in yard, kiln and planer will be ready for publication in the Timberman as soon as the rough draft of the text can be revised.

Seasoning degrade in pine is not serious except in wide stock. Degrade in fir is much heavier than in other species. The average degrade was about 18 - 19% by volume, millrun, in air dried white fir, but less than 10% in the kiln dried material studied. The latter, however, was not dried to as low a moisture content as that piled in the yard.

Degrade increased with increase in board width, 12" material depreciating three to five times as much as 4-inch stock. The grade showing the largest percentage of volume degrade (though not the heaviest value loss was No. 2 Common. 48% of this grade in 4/4 x 12" stock fell to lower grades, chiefly to No. 3 Common. C & Better lost the most in value during the seasoning process, the maximum being about 20% in 4/4 x 12" boards, half of which was restored by trimming and ripping (rough basis; there is a further loss in surfacing).

Samples of Sugar Pine Degrade

Air dried sugar pine. 6/4" thick

Width	Grade	% on grade after drying	% on grade after trimming and ripping	% raised in grade from original
4-11	1&2 Clr	90.2%	96.0%	
12-19	" "	84.2%	91.5%	
12-19	C.Sel.	79.7%	82.9%	3.9%
12-19	2 Com.	84.3%	85.6%	

Planer degrade is very heavy in the Selects. Sugar pine and western yellow pine clears were only 60% on grade after surfacing.

In general, the degrade studies at Standard and at Pinedale have provided some much needed information on depreciation in specific grades and sizes of lumber. Besides establishing more accurate degrade factors for use in appraisals, the investigations will provide a basis for analyzing the

details of present seasoning practices and for suggesting possible methods of improvement.

Old Regional studies, which were exhumed from the files for comparison with the new data, are based on old grading rules. Furthermore, kiln drying and air drying practices have been so greatly improved that the former results are no longer valid, even if the grades had been the same as at present. It is not believed worth while to do anything further with the now obsolete reports.

C. B. Green's studies, however, will be valuable for judging the probable efficiency of drying practices in the recent investigations.

Plans are to publish all degrade information now in process of computation, within the next five months. Additional degrade studies should be conducted in connection with future woods and mill projects.

Little Used Species - White Fir. The woods and mill data needed to round out the white fir study are now available from the Stanislaus project. As may be readily seen from a review of the comments and figures under "Woods and Mill Study", the outlook for immediate betterment is not bright.

The year 1930 found increasing prejudice against the species in eastern markets. Local markets were also poorer than before. Selling prices dropped as much as 25% for certain grades. Only about half as much white fir was sold in 1930 as during previous years the rest accumulating in yards and sheds.

The mill man can improve his products by better drying and a revision of dimension grading rules, but even though demand is thereby increased, there is little hope for any increase in selling prices.

These are controlled by northwest Douglas fir, which shows no indications of going up.

There are few if any lumber uses where white fir is superior to other species. For the most common uses it is inferior. There is no doubt on this point. It is difficult, therefore, to attempt to improve the status of white fir by the publication of bulletins and trade magazine articles. Nevertheless this is about all that can be done by the Forest Service at present. The manuscript for the white fir bulletin will be ready for the printer by July 1, 1931. R. P. A. Johnson of the Forest Products Laboratory and Brundage will be co-authors. The publication will be similar to the recent bulletins on other little used species.

Lumber Stain Study The Sugar Pine Lumber Company stain study data are punched on cards at Madison. Tabulating instructions will be prepared during March. The Laboratory will then make the runs from time to time and these will be worked up in report form as opportunity offers.

It will be desirable to publish a trade journal article before the next staining season sets in. The investigations proved that certain compounds were very efficient in reducing stain losses and the industry should put them to use. If they do not, there is no valid reason why the Forest Service should allow any more depreciation in appraisals for winter stain losses than those shown in the studies to follow the most effective treatment.

By-Product Studies

Heptane. The office report on the heptane experimental project, indicated at last year's meeting of the Committee, was completed and has been used by the Regional Office of Forest Management in determining the provisions of a new heptane cuppage contract.

Some of the more important conclusions and recommendations resulting from this two-year study are the following:

1. The yield of mature trees decreased some 17% in the second year as against the first. The yield of blackjacks increased by nearly the same amount. This was apparently due to the greater vigor of the young trees and their consequent power of response to the wound stimulus of the first year, whereas the low vitality of the old trees prevented their making such a response.

2. The narrower the streak the higher the yield so long as the plugged mouths of the resin ducts are completely open. A 1/16" streak accurately made will open the ducts but, with the hacks now available, it is impossible for the average workman to cut a streak narrower than 1/4".

3. The deeper the streak the greater the yield up to 1/2" depth beyond which we did not go. The danger of severing an undue proportion of the living sapwood is especially great in such old and slow-growing trees as our mature Jeffrey pines. No deeper streak than 1/2" should be commercially adopted until it is clearly proved to be safe.

4. Angle of streak is unimportant and must, for convenience of operation, vary with the height of working from the ground.

5. Covered cups show consistently smaller yield than open cups, and

this decrease is approximately twice the amount which can be accounted for by the inclusion of trash in open cups. This result is hard to explain, in view of the greater evaporation from open cups, but the recorded results are among the most strongly supported ones in the entire experiment. Cup covers may nevertheless be profitable through their saving of the extra costs necessary to remove trash from open cup oleoresin.

6. The Wernecke upward-peak face does not produce a higher yield and its supposed effect upon subsequent healing of faces rests upon unsound physiological reasoning. The Gilman-McCall closed cup produces extremely pure oleoresin but is subject to heavy breakage, and the augur hole tapping, for which it is designed, is slow and expensive to operate and is ineffective in gum yield.

7. Medium width faces gave greatest yield in these experiments. Whether these results are valid or not, wide faces should not be used on Jeffrey pine because of excessively slow healing in large old trees.

8. North faces gave only about 3/4 the yield of south, west and east faces, whose yield is approximately the same.

9. A small hack is superior to a large one for cutting narrow streaks.

10. Aprons attached by one-inch roofing nails to grooves in the bark gave a larger yield than aprons inserted in axe cuts, because they avoid the physiological injury of the axe cut.

11. Double chipping showed less decline of yield in the second year than weekly chipping, on mature trees. The evidence from Dr. Gerry's work on southern pines is, however, so conclusive in respect to the damage of double chipping to tree vitality that this method should not be used.

12. Beetle attack was not intensified, or concentrated, on tapped trees by the tapping operation.

The resumption of the commercial sale raises again the question of the feasibility of further experimental work. There are a number of factors of considerable importance, from the standpoint of that project, which still await solution. Such are evaporation of heptane from the oleoresin; new forms of face, especially the so-called German-American face which seems extremely promising; a restudy of width of faces and width of bark bars; a study of depth of chipping with relation to the effect of physiological functioning of the sapwood also; a further microscopic study of wood structure as effected by tapping, this through cooperation with Dr. Gerry of the Forest Products Laboratory if it still seems to the Investigative Committee that the economic value of probable tapping sales in the national forests

is too small to warrant the expenditure of the research money which would be necessary to secure further results, well and good; but it seemed that the bearing of the new sale and the present point of view of the office of Forest Management should be brought into the picture before this year's Committee.

Economic Projects

California Economic Research Council. The study of land use has continued as a major activity of the Natural Resources Committee. This has resulted in a concrete undertaking of a land use study for Eldorado County under the direction of Professor David Weeks of the University of California and direct cooperation in this study by the Experiment Station.

Eldorado Land Use Project. The general plan and organization of this study has been made by Professor Weeks in consultation with the Station. He will undertake general direction and supervision. The Station will supply additional intensive vegetative type mapping on sample areas to be subjected to intensive study, will conduct or direct the analysis of forest conditions and jointly participate in the analysis of the relation of forest and woodland to agricultural areas in the marginal zone, as well as the general conclusions involving interrelation of major uses. This study should contribute greatly in respect to clarification of procedure and methods, for future more extended undertakings in land use study and to the indication of relationships for the Forest Survey project of the Forest Service. Assignments in the Station participation will be between Kotok and Hill. Details have not yet been worked out.

Wood Uses and Requirements. Sources of information in respect to this project, as planned in last year's report, have been canvassed to a considerable degree and the organization of tentative plans begun. Reports on building and construction operations both by city and county governments have been greatly improved in this State within the last two or three years, both in completeness and comparability, through the efforts of the California Economic Research Council. Data necessary for our project in this field will be much easier to obtain than they were previously. A vexing problem at present is how to obtain the total fabrication use of wood for the State without going into a detailed wood-using industries study. The latter is highly desirable on its own merits, and may be necessary in this connection if funds and personnel can be secured. Plans for the definite undertaking of the wood uses study depend upon those for the assignment, or availability for this purpose, of Forest Survey cooperation.

Statistical, Inspection, and Cooperative Activities.

The lumber census continues as heretofore; also inspection work on

existing wood preservation installations. Under the latter, the September inspection of special treatments under exposure to marine borers showed Montan Wax and Rutgerswerke treatments still standing up very well although showing incipient Limnoria attack on practically all specimens; Western Union treatments were for the most part heavily attacked and two out of five series practically destroyed.

The Termite Investigations Committee, to which Hill gives cooperation, has reached the stage of preparation of final report. As in the case of the Marine Piling Committee no revolutionary discoveries have been made. But the tremendously increased knowledge of the distribution and habits of the insects concerned, and thus of the bases of validity of methods of contr together with the education of engineers, architects, contractors and the ge eral public which has been accomplished should result, as it did in the case of the marine piling work, in greatly improving the standard of practice and in reducing the termite menace to a controllable status. The report is expected to be considerably more extensive than that of the Marine Piling Committee, approaching some 750 pages.

A Look Ahead

In respect to the more specifically Products field it seems apparent that the present trend will continue, for the field units, chiefly in the direction of the correlation of log product, woods and mill wastes and costs of production with the character of standing timber and methods of silvicultural management, toward a better approximation of the financial returns of timber operation on a forestry basis. If Brundage's indication is sustained, that future woods and mill studies can more cheaply and equally well be conducted separately, tying the standing timber and the lumber product together through the medium of intensified log grades and without the necessity of both being conducted upon the same identical logs, the problem will be materially simplified. The work on projects now in hand will preclude taking on further mill studies before the season of 1933. It would apparently be possible, however, from the standpoint of the combined studies, to make the silvicultural studies in the fall of 1932 on timber to be studied in the mill in 1933. On Brundage's basis two of the segregated studies could well be made on the East Side timber types and sites, each continuing about a week, and one or two more on the West Side, the latter especially for more common type and site conditions than those on the Stanislaus study. With silvicultural work now begun in the redwood region, it is also highly probabl that woods and mill studies will be desirable there by the year 1934.

A distinctly Products type of study which would seem to be a logica offshoot from the woods and mill studies would be a study of the results of gang-saw operation upon the amount and quality of product and cost of production of California lumber. Such studies would not be merely a subsidy to the lumber industry. The industry is now trying to boost the minimum size

of top diameter on national forest sales, especially in respect to white fir, and the results of Brundage's studies thus far seem to give some support to that position. If, as seems highly probable, the use of gang-saws on smaller logs would produce a larger footage by reducing kerf, and also produce a cheaper product than can be obtained by sawing such small logs on equipment having a capacity for the largest logs, that fact would seem to have an important bearing upon the possibility of maintaining sale utilization standards without unjustly penalizing the purchaser. Admission of the validity of this type of study might open up an uncultivated field of Products work.

In the field of Economics projects, undertakings by the Experiment Station should doubtless, for the present, be limited to items which will contribute directly toward the work of the Forest Survey when that shall come into California. Reference has been made in connection with the Wood Uses and Demand project, to the way in which it appears likely to carry along with it a wood-using industry study. In another direction the same project leads into market studies. In fact, if valid conclusions are to be reached respecting the significance of use and demand in relation to standing national forest timber of the Region, that study will almost necessarily involve a consideration of the sources from which present supplies are now drawn for the respective market areas. Such extensions of the Primary Wood Uses study as these of markets and wood-using industries can not be made with present personnel and resources. This raises the question whether their importance to the Forest Survey does not justify its application of funds to them under Station direction, in addition to their present contribution to the Regional Type Map; this purely on the basis of speeding up the total Forest Survey job.

It will be seen that these economic studies will directly contribute to the Regional major project, "California Forests in Relation to Social and Economic Development", of which the wood uses group of studies, thus interpreted, might be construed as sub-projects in the same way as the Type Map is now carried. If the wood-using industry and markets offshoots of the wood uses project can not be carried through for several years, it will either unduly delay the wood uses study itself or will unfortunately restrict its scope and value. The application of the land use study to the work of the Forest Survey and to the future development of forestry as a land management problem should be obvious. The Station should, of course, confine its direct participation in such studies to the phases directly connected with forest land.

Plans for 1931

Hill will finish the hectare bulletin; write an article for local publication on the land use study; and complete the plans for wood uses and requirements work. There are also a number of other jobs of writing, mostly

for supplying current information frequently asked for. Among such jobs are mimeographed accounts of the uses of California hardwoods, the seasoning of California oaks and the production of cascara. Another such which badly needs writing is a connected account of the forests and forest resources of this State.

Brundage will be occupied for the entire year, and probably more, in winding up the Pickering Woods and Mill project now under way and writing the contemplated material for publication.

Mason has thus far been helping Brundage pretty nearly exclusively. He ought to be given a chance for work on his own account. He cannot be diverted from Brundage's work without serious consequences there, unless additional experienced help can be financed for Brundage. As to work for Mason to take over himself, there are the following possibilities: The gang-saw study previously mentioned as growing out of the woods and mill study, and/or some diversion of the economics study, such as the wood using industry study or a market study or the study of California Douglas fir as one of the little-used species. The latter study would be almost entirely an economic and market study, involving no technical difficulties such as beset the white fir. The other main inferior species in this Region, namely, incense cedar, is not believed to be promising as a subject of study at the present time.

Action by Committee

In respect to the woods and mill study, the Committee agreed to the desirability of using "synthetic", or built-up, trees for purposes of analytic study in future projects instead of carrying actual trees throughout the record as was done in the present study, if the results of this study should establish the soundness of that procedure; also, the undertaking of no new projects before 1933.

In respect to the heptane project, the Committee approved taking up no further experimental work until we could see what will be the outcome of the renewed commercial sale.

In respect to requirements studies, see the discussion under Forest Survey.

Chairman Show, for the Committee, expressed their special approval of the alignment and results of the Products program.

Report of the Consulting Forest Entomologist

Submitted by

John Miller, Bureau of Entomology

Barkbeetle Control

Except for a very limited amount of work carried on by private owners on recreational areas, there have been no going projects within the region during the past year on which to base studies of this activity. The Pickering Project on the Modoc covered in the report of last year was not continued, due to the fact that the 1929 losses within the area were not considered to be heavy enough to warrant control work.

Devil's Garden Extermination Experiment. This project was continued by the Bureau of Entomology during the year, and the area covered to remove infested trees of both the summer and winter broods. The work so far has been carried on during a period of great decline of the infestation from natural causes, and the reductions secured by this intensive control work have been comparable to the decline in the Badger Unit. The project will be continued during the season of 1931.

Effect of Logging Operation on Bark Beetle Infestations. This study was planned to start during the 1930 season on the Pickering sale on the Modoc. The indefinite postponement of this operation made it impossible to go ahead with the plan, and facilities were not available for starting the proposed studies elsewhere in the district. A decision was reached to combine forces with the Portland Station of the Bureau of Entomology, and to carry on the study for the time being on the Weyerhaeuser Timber Company's operation at Klamath Falls. This work was conducted by J. A. Beal, who will continue the project next season with an assistant assigned from the California Station. Results secured during 1930 have shown that the logs removed from a logging area carry with them an appreciable percentage of the beetle population during midsummer, and that the slash, if piled or spread where it received plenty of exposure to the sun, is so unfavorable to brood development of insects that there results a decrease rather than an increase of bark beetles attracted into it.

It is planned to complete the study during the 1931 season.

Biological Control of the Western Pine Beetle. The methods outlined in the report of last year were further developed and tested by Person. The effective mortality of the western pine beetle and survival of the clerid predators secured under varying exposures of the infested log to solar heat were determined by a series of experiments on the Modoc. This study has reached the point where further progress can best be secured by trying out the proposed methods on an experimental project. Further work on this project will not be undertaken until funds can be secured and a suitable area selected to initiate a project to test these proposed methods.

Reduction of Insect Loss Through Marking

No further work was done on this project except the reexamination made by Person of the two experimental thinning plots on the Modoc. Logging operations to include the three 160-acre plots selected on the Modoc sale area are indefinite.

Interrelation of Insects and Slash.

A study of the infestation developing in right-of-way slash in western yellow pine stands on the Modoc was carried on under Person's supervision. This study, together with Beal's work at Klamath Falls, has for the most part confirmed the conclusions reached by Patterson and Person in previous work. Aside from the influence of the logging study mentioned above, which will be carried on at Klamath Falls in cooperation with the Portland Station, no further work on this problem is contemplated for 1931.

Climatic Factors in Relation to Insect Epidemics

Progress in this study must necessarily await the development of the regional survey project which will be initiated during 1931. Since these two projects must be carried on jointly, they will be combined as to plans and assignment.

Relation Between Insects and Fire Damage.

The two plots laid out in 1929 within the area covered by the Sugar Hill fire were again examined by Person and a progress report has been submitted. About 20 per cent of the trees of Class V fire injury (over 75% defoliation) had succumbed within a year after the fire. Records from these plots will be continued for three or four years until the final effect of the fire injury upon insect attack has been determined.

Regional Survey of Insect Damage

This project has been set up on the District Investigative Committe

program since 1925, but the study has been held up awaiting the funds and personnel necessary to carry it. During the past year K. A. Salman was assigned to the project as leader and some preliminary work carried out. It is not planned to initiate, during 1931, a program to secure long-term records of bark beetle infestations within the region. The personnel available for the coming season will consist of full time of the project leader and a three-man survey crew for a three-month period.

In initiating this study it will be necessary to concentrate upon the western pine bark beetle, which constitutes, from an economic standpoint, the most important forest insect problem of the region. Work on other important insects, such as the mountain pine beetle in sugar pine, cannot be undertaken on any worthwhile scale with the resources now available.

This undertaking will involve records extending over a wide range of type, site, soil and climatic conditions, and which would extend geographically from the northern to the southern limits of yellow pine within the state. It will be impossible to secure the information that is desired except upon the basis of carefully considered sampling of the representative types and conditions that are to be included.

Two phases or objects are recognized in the planning of this program, viz:

1. To obtain information annually concerning the intensity and trends of forest insect infestations in the forested areas of Region 5;

2. To attempt to correlate the intensity of forest insect infestations with physical characters of climate, soil, altitude and topography, with biotic factors, such as character of the forest cover, parasites and predators, and with man-made factors, such as methods of cutting, slash disposal and right-of-way clearings.

The first object is intended to supply information of immediate value which may be used (1) by the Bureau of Entomology in analyzing forest insect conditions in Region 5; (2) by the Bureau of Entomology in determining the location of areas of high and low insect hazard; (3) by the Bureau of Entomology in pointing out infestations of importance to the Forest Service; (4) by the Bureau of Entomology in selecting areas supplying material upon which the detailed "laboratory" investigations of the Bureau depend; (5) by the Forest Service and others as a basis for control work or salvage operations; (6) by the Forest Service as a basis for obtaining information regarding the most effective timing of insect control work; (7) by the Forest Service in determining the extent of monetary loss in given areas, either present or anticipated.

These purposes may be attained (1) by selecting and cruising check areas often enough to supply data from which losses and trends of infestation can be calculated; (2) by selecting a sufficiently large number of areas to constitute a fair sample; (3) by supplementing data from check areas by data from road strips, strip counts, topographic counts etc., which need not be the same each year, but which may be selected as a sample of the existing conditions of infestation.

The second object will involve the building-up of a mass of data from the more intensively studied check plots, from which interpretations can be made. It will require the setting up of intensive studies on a few selected areas, similar in character to those that have been under way on the Modoc by Person.

With the present resources available in man power, only the first object stated above seems possible of attainment. During the coming seasons sample plots which have already been selected on the Modoc, Lassen and Sierra will be mapped, tagged and inventoried as a basis for permanent records. A considerable part of the season's work by Salman will be given over to reconnaissance of other forests, preliminary to the selection of further plots. Under the present program it will be possible to complete the selection and permanent marking of plots to cover the region to be studied during the course of the next two or three seasons. The plots and other sample areas will be set up progressively as the work develops.

Some progress on Object 2 may be possible, particularly as regards the correlation of available weather records and growth conditions with the fluctuation of infestation.

Attraction Studies with the Western Pine Beetle

The work on this project during 1930 was confined principally to chemical and physiological studies by Jeffrey and Durbrow. Previous work indicated a change in the sugar concentrations and acidity of the inner bark of trees usually considered attractive to the western pine beetle.

The purpose of the 1930 studies was to check this point by making sugar and acidity determinations on a large number of trees representing decadence and various types of injury. A series of determinations were made on trees artificially injured early in the season by top pruning, root pruning, girdling and defoliation with fire. About 70 additional determinations were made on trees variously attacked by other insects and representing all stages of attack by the western pine beetle. Enough determinations were made on healthy, non-attractive trees to serve as a basis for comparison.

Jeffrey is still working on the sugar determination of samples preserved in alcohol, and the complete results will not be available for two or three months. Enough work has been done, however, to show that in general trap trees, injured trees and decadent trees--which have been found to be more attractive to the western pine beetle than normal healthy trees--all show a definite tendency toward an increase in levulose at the expense of sucrose, and an increase in acidity. This indicates a sucrose hydrolysis in these abnormal trees which might reasonably result in the formation of volatile aldehydes or esters which would account for the attractiveness of these trees to the western pine beetle.

It is planned to bring this work to a close in 1931. Durbrow has prepared a report covering his studies on the H-ion concentration of the inner bark of the trees studies, and Person has submitted for publication a manuscript giving a general review of this project with the results obtained.

Jeffrey is now completing the analysis of the samples collected last summer. He plans to write an article for some technical publication in which he will give the details of the chemical studies which have served as the basis for this work.

Nutritional Studies of the Western Pine Beetle

This project was proposed last year and its purposes defined. No assignment has as yet been settled upon and no progress was made, except in so far as Jeffrey's work on attraction can be applied to an understanding of the food requirements of this insect. This study appears to be the next logical step in further biological studies. Plans for its continuation are indefinite.

Insects Affecting White Fir

This was set up last year as a new project because of the emphasis given to the problem on the MC plots on the Stanislaus and the recent development of white fir losses in recreational areas in the central Sierra region.

Work was started by Struble at the Stanislaus Base. The life history phases of the fir engraver, the primary insect concerned in white fir killing, have been pretty well worked, but another season will be necessary to supplement and verify the work of last year. Further work with associated insects is also necessary.

The association of a fungus organism was definitely connected with the successful attack of the fir engraver. This was isolated and the typical cambium killing of the fungus was produced by artificial inoculation. The amount of losses attributable to insects was determined on a series of plots

established by the California Forest Experiment Station, representing cut-over and virgin stand conditions.

The project will be continued in 1931 on the same basis. Some attention will be given to the development of control methods which can be applied on recreational areas where white fir is desirable for cover purposes.

Action by Committee

The Committee was impressed with the inadequacy of appropriations for entomological research and the lack of proportionate recognition to the needs of California. The Committee instructed the Chairman to see that renewed representations were made through the Forester in respect to the importance of strengthening entomological research in California.

Report of the Consulting Forest Biologist

Submitted by

E. E. Horn, Biological Survey

There has been no change in the status of this office since the meeting of the Investigative Committee a year ago. Funds for the assignment of a biologist to Experiment Station projects have not been available. The entire time of the Biological Survey representative now located at the Statio has been required upon investigations of methods of control of rodents and predatory animals. Whether or not an assignment of a biologist under provisions of the McSweeney-McNary Act can be made this year was referred to Dr. W. B. Bell, In Charge Biological Investigations, Biological Survey, Washington, D. C., for direct reply to the Director of the Experiment Station.

Two main problems of immediate interest to the Station program are:

1. Relation of animals to regeneration and planting.

   a. Relation of birds and rodents to tree seed destruction and seedling survival.

   b. Relation of rodents to burned areas, the rate and extent of return of animals to these burned areas, and the direct relationship of such return to natural or artificial reforestation.

   c. Effect of timber cutting upon animal population and the effect of animals upon regeneration both natural and artificial upon these areas.

2. Effect of animals, especially burrowing animals, upon the structure and functions of soil profiles, both in respect to water disposition and to evaluate the true role of such species in nature. The effect of burrowing animals may be beneficial or detrimental, depending upon their abundance. Measurement of their influence in matters of erosion is important. To judge an animal's status on the basis of forage plants consumed and the actual food value of these forage plants only tells part of the story. Possibly this same animal more than pays for his keep as a tiller of soil and conserver of moisture.

These problems are suggested as a nucleus upon which to start the studies with which the Forest Biologist of this Region will be concerned.

Action by Committee

Report approved. Discussion of this report revolved, as in previous years, about the extreme importance of having a biologist assigned to research work in California, without which progress is going to be seriously curtailed in important phases of the forest influences and erosion work and a number of other lines of work. The committee moved to reaffirm its stand of previous years and to urge the Forester to endeavor more strongly than ever to get the Biological Survey to make such an assignment.

Articles and Publications

Published from March 1, 1930 to April 1, 1931.
(Addresses and unpublished manuscripts not listed)

M. R. Brundage

Dipping pine to prevent stain.

Timberman, May, 1930.

When is a tree ----,

California Countryman, April, 1930.

C. L. Hill

1929 lumber cut of California and Nevada.

Timberman, October, 1930.

Why California lumber cut for 1929 shows increase instead of prophesied decrease.

Pacific Purchaser, December, 1930.

The development of forest research in California.

Journal of Forestry, April, 1931.

E. I. Kotok

Erosion: A problem in forestry.

Journal of Forestry, February, 1931.

Influence of forest cover on water supply. Investigations relating to South Coastal Basin, conducted or proposed by the California Forest Experiment Station.

California Department of Public Works, Division of Water Resources. In Bulletin No. 32. "South Coastal Basin".

The determination of hour control for adequate fire protection in the major cover types of the California pine region. S. B. Show and E. I. Kotok.

U.S.D.A. Technical Bulletin No. 209, August, 1930.

Fire, a problem in American forestry.

The Scientific Monthly, November, 1930.

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REPORT OF THE REGIONAL OFFICE
U. S. FOREST SERVICE

Office of Forest Management

No new investigative projects were undertaken by the Office of Forest Management in 1930. Continuing projects and experimental work conducted on the Forests of interest to Forest Management are reported upon as follows:

Slash Disposal Experiments

In accordance with the decision reached by the Committee last year, Woodbury spent some time on the Stanislaus and Lassen Forests last season gathering data in co-operation with local Forest Officers for the preparation of a progress report on the Old Miner's Ditch project, Stanislaus and the Fruit Growers Supply Company project, Lassen. Burnett of the Stanislaus, and Edmonds of the Lassen spent about a month this winter in the Regional Office working up the data on these experiments.

Stanislaus. The protection force in the 1930 season comprised one lookout and one patrolman. Following the practice of the past few years, the area was closed to the public during the fire season. There were no fires within this area in 1930. Since the inauguration of this experiment in 1923, there have been 31 fires with a total burned area of 18 acres.

Through careful measurements on sample plots, Burnett derived the following data on the amounts of slash material resulting from cutting left on the ground on portions of the area where different methods of slash disposal were used and where wood was (1) utilized for donkey fuel, (2) not utilized for donkey fuel.

Volume in Cubic Feet per Acre
Left on Area

Material 1/2" to 4" diameter		Over 4" diameter	
Area Where Brush Was Piled & Burned	Area Where Brush Was Scattered	Area Where Wood Was Utilized for Fuel	Area Where Wood Was not Utilized for Fuel
52	299	107	690

On the basis of volume of wood material left on the ground, the

minimum hazard is on the areas where brush was piled and burned and the bulk of large material utilized for donkey fuel. On such areas the volume left per acre was 159 cubic feet. The maximum hazard on the same basis is on areas where slash was scattered and no material utilized for fuel. The volume left on such areas was 989 cubic feet per acre.

It is apparent that piling and burning where large material is not utilized reduces the hazard very little, considering only volume of slash. Burnett points out that the inflammability of slash is a most important factor of fire hazard, and that this is influenced by the extent of deterioration and position of the slash on the ground. Considerable data on this point were collected, but have not been worked up in final shape as yet.

In order to determine the influence of slash on the cost of fire control, fire trails were cleared to mineral soil under the various conditions of slash disposal with the following results:

1. Slash piled and partly burned - time for construction 7.92 min. per 100 feet.

2. Brush scattered - fuel utilized - 11.95 min. per 100 feet.

3. Brush scattered - fuel not utilized - 12.65 min. per 100 feet.

From the above it appears that it takes 51% more time to construct trail through scattered slash where the fuel has been utilized, and 60% longer through scattered slash where fuel has not been utilized than on areas where the brush has been piled and burned.

Lassen. In 1930 there were 8 fires covering 3 acres. Since the inauguration of this experiment there have been 70 fires with a total burned area of 87 acres. Twelve of these fires covering a total of 35 acres resulted from fire line clearing.

Last season the experimental plan was further modified through the extension of this fire line system to compartment A, East Crater Mt. Unit, comprising 1500 acres Government, 700 acres Fruit Growers Supply Company, and 200 acres other ownership; and combined brush piling and fire line system to Compartment B with 3300 acres Government, 400 acres Fruit Growers Supply Company, and 40 acres other ownership.

The following are a few of the high-lights of Edmond's study:

1. On the Fruit Growers Supply Company fire lines where brush is scattered or windrowed, and a clean burn secured, the germination of brush species is enormous - 13,000 to 50,000 seedlings per acre. Adjoining check

plot with one inch duff indicated that burning had accelerated germination of snow brush 50 times. Indications are that on areas covered by big brush piles and logs the heat in burning is so intense as to destroy a large proportion of the brush seed.

2. Lopping of tops is of doubtful value. This has been discontinued.

3. Damage done by brush piling and burning as compared with the fire line system:

Destroyed, Per Cent by Number.

		Piling & Burning	Fire Lines
Reprod.	0-6' high	9.1	9.1
	6' high - 3½" D.B.H.	3.5	9.4
	4" - 11" D.B.H.	3.7	6.8
	12" D.B.H. & larger	.3	2.7

By area destroyed, the comparative figures are 6% for the brush piling and burning system, and 8.5% for the fire line system.

4. Edmonds calculates the cost of the fire line system on Government land at $.50 per M and that of brush piling and burning at $.62 per M. Both figures include snag felling, which has amounted to about $.17 per M for this area.

It is regretted that time has not been available to digest the reports made by Edmonds and Burnett and draw tentative conclusions. This will be done before the field season if possible. It seems clear that this type of hazard reduction has a place in National Forest timber sale practice. Probably a combination of brush piling and burning and the fire line system will come more and more into use, and will tend to replace the uniform piling and burning system heretofore employed in this region on National Forest lands. This is a continuing project, and final conclusions will not be drawn for some years.

Spark Arrester Study

The chief development in this study last season was in connection with oil-burning locomotive arresters. The California Forest Protective Association purchased for study purposes two of the front end type arresters, one of which was installed on a locomotive of the Diamond Match Company, and the other on a Pickering Lumber Company locomotive. Without infringing on these patents, a home-made arrester of the same general type was developed by the Pickering Lumber Company which has given excellent results. Mr. S.R. Black, Secretary Manager of the California Forest Protective Association

reports that this type has now been adopted generally in the California Pine Region. The results as regards reduction of locomotive fires are most satisfactory. Mr. Black reports that in 1929 there were 22 locomotive fires in logging operations, while in 1930 there were only 8 such fires.

Experimental Planting

As was reported in our memorandum for the Committee of last year, the 15,000 transplants from the Feather River Nursery sent to the Lassen, Modoc, Tahoe, and Inyo Forests, were heeled-in for planting in the spring of 1930. On the Tahoe, however, the trees (3400 western yellow pine) were planted under favorable conditions in late winter with fair survival. Complete failure resulted on the other Forests, due either to improper heeling-in, or to being heeled-in for too long a period. Eighteen western yellow pine and Jeffrey pine sent the Modoc in the spring of 1930 which were planted on the Sugar Hill burn showed 80% survival last fall.

In the fall of 1930 about 14,500 western yellow and Jeffrey pine 1-1 trees from the Feather River Nursery were planted on the Shasta, Sierra, and Stanislaus Forests, chiefly on severely burned areas. This planting was done by members of the administrative force.

Forest Management suggests that the Committee consider carefully the advisability of the continuation of the Feather River Nursery. The Susanville Nursery is now under way, and nursery experiments can be economically centralized there. In any event, we feel that more assistance is needed from Research in directing planting experiments towards the solution of definite planting problems and in following up results.

Nursery Experiments

Corson has conducted three experiments at the nursery which are of especial interest.

1. In five test plots, trees were root pruned at various depths and at different periods. All these trees were planted on the Antelope burn the past fall, and for stock from each plot a complete record was made of the character of trees and planting conditions. A record will be kept of the development of each lot of this stock.

2. Following soil analyses to determine acidity, it was decided to treat a portion of the seed beds with flour sulphur at the rate of 1/2 pound per 10 square feet. Treated areas showed practically no losses from root rot, while on untreated areas, losses from this cause in western yellow pine amounted to 21% and in Jeffrey pine 26%.

3. Two seed beds, one of western yellow pine and one of Jeffrey pine were treated with a zinc sulphate solution (13 oz. in 6 gals. of water) for weed control. This was applied immediately after the beds were sown and covered. The first check at the end of May showed about 3 times as many weeds on the untreated beds as compared with the treated beds. The second check, in the middle of June, showed twice as many weeds in the untreated beds.

California Cover Type Map Cooperation

One of the chief accomplishments of the past year in connection with this project was in conveying to the Supervisors and their technical personnel an understanding of its importance and of the standards which should be followed in the collection of field data and the compilation of reliable existing type data in the office records. Wieslander and Dunston discussed this project with Supervisors and their staff men on those Forests which they visited last season in connection with the selection of Natural Areas and Experimental Forests and cleared up doubtful points both as regards the use of office data and the technique of field work.

Revised instructions for this project for all except the Southern California Forests were prepared by Wieslander and sent to the field in December. A memorandum was written each Supervisor transmitting these instructions and discussing the conduct of the work on his Forest. A progress report will be submitted from each Forest early this spring. It is known that the work is being pushed vigorously on all Forests where the personnel is available for its conduct. With the exception of the Klamath, Trinity, and California Forests, where little has been accomplished due to either poor maps or lack of men to handle the job, this project should be completed by the end of the 1932 field season. On the three northern coast Forests it may be necessary to assign special men to it.

Taper Tables

Junior Forester A.N.Weber of the Eldorado spent a month in this office this winter compiling new Site II taper tables for western yellow pine sugar pine, and white fir. As was reported in last year's memorandum, the original data used by Dunning for the volume tables now in use are the basis for these new taper tables.

Cull and Breakage Studies, Lassen

Senior scaler Fred Schott conducted cull and breakage studies on th cutting areas of the Red River Lumber Company exchange (Chester Unit) and the Lassen Lumber and Box Company sale (Norval Flat Unit) with the following

results:

Chester Unit

Species	Per Cent of Breakage	Per Cent of Cull	Total Per Cent of Waste
Western yellow pine	2.76	2.54	5.30
White fir	10.14°	15.76	25.90°
Incense cedar	.82	46.82	47.64

Norval Flat Unit

Western yellow pine	2.00	3.60	5.60
White fir	4.70°	31.30	36.00°

°This does not include loss in the conky, sanitation clause trees. The study will be completed in this respect this season.

It is planned to continue and enlarge upon these studies on the Lassen, and it is hoped that similar studies will be undertaken on other Forests to the end that eventually a fund of reliable cull and breakage data will be available for all important type and stand conditions in this Region.

Action by Committee.

Report approved.

Office of Range Management

Management of Browse Range on the Tahoe National Forest

Mr. Smith collected samples of sweet birch on various dates during the season and sent them to Dr. Hart at University Farm, Davis, California, for chemical analysis. The results secured were the same as in 1929. The percentage of protein decreased and the nitrogen-free extract and fat increased with advancing stages of maturity. The percentage of phosphorus declined steadily as the season advanced. There was a marked increase in the calcium content of the samples collected August 21 as compared to the previous collection on August 2. This great increase in calcium together with the decrease in phosphorus brought the C:P ratio to the season's maximum. This time coincides closely with the time cattle were observed to leave the birch browse. The fibre content was higher in 1930 than in 1929 and can be attributed to a larger amount of seeds and twigs in the samples. Cattle ate the seeds in 1929 but only a small percentage was eaten in 1930. An examination of the seeds revealed the majority to have been damaged by insect larvae.

Bone meal was furnished by Mr. Forbes, the stockman, and put into a few salt logs. Salt consumption had decreased to one pound per month per animal during August and the cattle showed no craving for bonemeal. Though considerable bonemeal was eaten it is probable that the amount was not enough to be effective.

Because of impossibility of control on the open range, either of numbers or use, it is desired to fence two pastures adjacent to each other, with an allotment of 20 head of stock to each; supplementary feeding of bonemeal in salt to be done in one field and not in the other; both bands of cattle to enter the respective pastures at same time and to be weighed at intervals during the season. The cattle will be looked after and salted by the rider the same as on the open range. The weighing and keeping track of feeding the bonemeal or other phosphorous compound to be done by a Forest Officer in charge of experiment.

This experiment would show rates and period of gains, season of proper use, time when the birch became less palatable and finally ceased to be of value, and whether addition of phosphorus to the ration caused the stock to continue utilization of the birch and whether gains were made and whether such gains were economically practicable. By keeping check of areas fed and amounts of browse taken under such conditions the capacity of birch browse at this elevation and under similar conditions of soil moisture and shade can be very closely determined.

The plan is to map in great detail the cover inside each pasture so that the area of forage in each pasture is accurately shown on a map of at least 8" to the mile; without such a type map comparison would not be possible. This type map can be made during the summer at any time while stock are on the range.

The pastures should be located so as to have sufficient water to take care of the number of stock to be grazed and as nearly as possible similar conditions as to site, cover and amount of browse.

The continuation of this project is contemplated and the University Farm staff have signified their intention of gathering more data on supplemental feeding and forage values of birch in 1931. Their cooperation is much appreciated and it is to be hoped that we can carry on this project until we can secure data of value that can be used on all browse ranges of this type.

The size of the pastures will be governed by the amount of money available. Fencing in this country will cost about $300.00 per mile.

We have learned recently that Mr. Forbes, the stockman, may not take his cattle to the mountains this season. He was very cooperative and it will be a serious drawback to continuing the experiment if he gives up the range. However this is a good range and no difficulty will be found in securing a new permittee. The trouble will be in securing the interest and cooperation of a new permittee in the project.

Artificial Reseeding (Poa bulbosa)

Results of the seeding made in the fall of 1929 were very spotted. In general seeding in southern California was unsuccessful. Most of the seeding in northern California also failed as rains came so late that seedlings were not well established before spring. However there were a few notable exceptions especially in the Nevada City region. On a few ranches good results have been obtained.

Messrs. Hanley and Hoover of Medford, Oregon, donated 300 pounds of bulblets with which to continue the study during the coming season. Early in October 20 pounds of bulblets were sent to the California, Cleveland, Eldorado, Lassen, Klamath, Modoc, Plumas, Santa Barbara, Sequoia, Shasta, Sierra, Stanislaus and Tahoe Forests. As we have had best success on good soils at rather low elevations, it was suggested that a portion of this amount be given to stockmen. Interest has been stimulated among stockmen and quite a number have bought seed from Hanley and Hoover.

Chemical Eradication of Poisonous Plants - Tahoe

Mr. Smith continued the study on eradication of poisonous plants and has come to the following conclusions as a result of the work to date:

1. Annual weeds can be killed out with calcium chlorate using the formula advocated by the manufacturer of Atlacide.

2. Perennial and shrubby plants require a stronger solution, 1½ to 2 times the strength of the formula.

3. Dusting the plants with the powder appears more effective on all species but is slower when using a small hand duster.

4. Dusting or spraying must be done during the early growing season.

5. Dusting or spraying of such plants as water hemlock has not been successful.

Effect of Grazing on Reproduction - Santa Barbara

Work on this project was brought up to date by Mr. Farley of the Sequoia Forest.

The two reproduction sample plots and the three vegetative quadrats were recharted.

Erosion Control

The building of inexpensive erosion dams has been continued. This is an important project and is being given more attention each year by administrative men.

The following notes are from Mr. Smith's report of erosion control studies on the Tahoe Forest.

> "Erosion control work on the Tahoe has been confined to stream channels to prevent further cutting down of the beds and further damage to meadow forage by drainage of flats. The building up of stream beds by the various types of dams already put in has been quite successful and it is confidently expected that the raising of the water table in the meadow areas will stop the drying out of such moisture requiring plants as sedges and eventually restore the old meadow vegetation to its former density and vigor.

Grasses and grasslike plants are reestablishing themselves along stream banks and flats that have been built up and the improvement so far secured is noticeable to the stockmen using these ranges.

The restoration of our mountain meadows by irrigation and by building up of stream beds so as to raise the water table to former level is very important and economically possible, but the larger erosion problems presented by sheet erosion on our slopes in timber and sparsely covered areas above timber line are not so easy of solution. So far, all we have done or are able to do is to attempt to secure an adequate cover by reduction of numbers of stock and rotation grazing.

The problem of erosion control on the forest is so large that building up of a small meadow here and there has little or no influence on the total erosion damage on the forest. If continued year after year, by all the field men, it would mount up, but the time and expense involved would be large.

The answer seems to be the recognition of erosion control as a major problem and expenditure of funds the same as we do on fences and trails or other improvement projects."

Forage Requirements for Deer - California

Mr. Robinson of the Lassen Forest recharted the quadrats on Bald Mountain. The following are excerpts from his notes:

"All browse species show utilization by deer. Large patches of manzanita and white thorn show close usage around the edges and any openings that deer can get into. Isolated bushes show constant cropping, the white thorn being eaten off to a low matted shape in many cases. The oaks, Garry and Brewer, which are abundant are apparently not cropped until later in the year (August 29-31) as the utilization is at present comparatively light. Sitter cherry is eagerly sought for and all accessible shrubs are eaten closely. The willows are but very lightly used at this date and large brome grasses growing up through the oak are untouched."

Natural Revegetation

In furtherance of this study by administrative men there are now

74 fenced plots, 16 unfenced plots, 46 fenced quadrats and 17 unfenced quadrats.

Grazing and Western Yellow Pine Reproduction - Modoc

Two enclosures have been constructed and two more will be built before the coming grazing season.

Effects of Different Methods of Cutting and Logging on Herbaceous and Shrubby Vegetation

Sixty mil-acre plots were charted by Mr. Beeson on the transects located by the California Forest Experiment Station near Pinecrest. The Experiment Station men had mapped these plots in all particulars except herbaceous vegetation. We should like to continue and enlarge this work during the coming season. If the Experiment Station receives an appropriation for grazing investigations this work would, of course, be taken over by them.

There was very little grazing capacity the first year after logging. Sweet birch was so badly damaged the tops were killed and new sprouts were sent up from the roots. The resultant forage was very palatable but easily injured. From the evidence at hand it would appear that cut-over lands should be protected the first year or two, or stocked very lightly. The amount of annual grasses and weeds which will come into a cut-over area can not be predicted. The abundance of this type of vegetation seems to depend entirely on the spring growing season and not the number of years since the land was logged.

Action by Committee

The Committee approved the report and there was unanimous agreement that the cooperation of administrative and Experiment Station effort already in evidence would make for most successful results.

Administrative Research

An informal report was given by Mr. P. P. Pitchlynn on the research or investigative projects now being carried on by National Forest personnel, and the plans recently put into effect by the Regional Office for the better stimulation, coordination and control of such work. Participation in investigative work by the field personnel has long been recognized as having distinct limitations, but as being, nevertheless, highly desirable, not only on account of the possible results on phases of forest practice in respect to which the field personnel is in the strategic position of most intimate contact with the facts, but even more because of the stimulating effect upon field personnel of the demand for systematic determination of facts as the basis for conduct of work. The difficulty has been chiefly in absence of provision for the strong and personal leadership necessary to guide such work and bring it to any fruitful accomplishment.

The Regional Forester's assignment of Mr. Pitchlynn to this task was heartily approved by the Committee as promising to give administrative men renewed interest in research and real value to their research efforts. The Experiment Station promised every assistance possible in bringing this about.

Report of the Consulting Forest Pathologist

Submitted by

W. W. Wagener - Bureau of Plant Industry

The annual program of work for Forest Pathology outlined to the Committee a year ago failed to make provision for several unforeseen demands on the time of the personnel and therefore not as much has been accomplished on some of the office projects as was expected. However substantial progress has been made, even with the necessary injection of several new problems, and we can look forward to further clearing the calendar during the next few months.

Pickering Woods and Mill Study

The compilation of material from this study has suffered considerable interruption but the following portions have been completed:

1. Estimates of cull from decay by species and plots, based on a 100% field estimate by individual trees and logs, of decay cull in the standing trees. The estimates have been worked up by means of both the old taper tables and by the new ones completed last year by Forest Management, thus affording a comparison of the two sets. The new taper tables gave volumes approximately 7.5% lower for white fir and sugar pine and 12% lower for yellow pine. The estimates, when compared with the actual cull per cents for the same groups, will give us an index of how accurately decay loss can be estimated in standing timber in the region and, with the application of the indicated correction factor, should give a close figure for the decay left on Plot 10 by the Mason system of marking.

2. A comparison of the scalers' deductions for rot as against the deductions indicated by the extent shown by the rot when the logs were opened up. The latter deductions were figured from diagrams of the rot made during sawing. For white fir the comparison showed that the deductions made by the scalers were about 31% too low.

3. The fire history of the plots secured from a compilation of the counted fire scar dates.

The further working up of the Pickering study material is being continued and should be completed during the coming spring.

Cull Studies

About a month was spent by Wright and Wagener in re-working all of our Sanitation and Cull Study figures from 11 areas, totaling 252 acres, on the Shasta, Plumas, Tahoe and Stanislaus to make them compare in arrangement with the several studies on defect made by Berry and Hughes of Forest

Management last year. The revised figures were turned over to Forest Management for their use in studying the effect of various factors on timber reconnaissance estimates.

Wagener has completed, in preliminary form, the paper mentioned last year on the progress of decay in white fir left uncut.

No field work on this project is planned for 1931.

Slash Disposal

This project was initiated for the purpose of following the progress of decay of slash in connection with the slash disposal experiments being conducted by the Forest Service on the Stanislaus and Lassen Forests. Other objectives of the project are to determine the principal fungi concerned in slash decay and to establish the influence of environmental conditions, and of species composition on the rate of decay. A total of 138 sample piles, 15 sample areas of scattered slash and a number of logs and lopped tops have been under observation on the Stanislaus since 1923-24. On the Lassen 91 sample piles and 1850 feet of sample strip through scattered slash have been followed since 1927 and 1928 as well as about 30 logs and lopped and unlopped tops. On both areas a pictorial record of the change in the condition of the slash is being followed through repeat photographs taken at intervals of one to three years.

Reexaminations on both areas were made during the past season by Wright and Gill. In general decay is progressing rather slowly. It is estimated that not over 5% of the seven year old slash on the Stanislaus experiment is decayed to any appreciable degree. In part this slow development of decay can be accounted for by the generally unfavorable weather conditions which have prevailed since the experiments were started although the pronounced seasonal character of our precipitation precludes any very rapid progress of rotting in slash. In connection with the report on the slash experiments recently prepared by the Forest Service a brief memorandum outlining the results to date with respect to decay was prepared for Forest Management.

The only activity on this project planned for the coming year is the reexamination of a portion of the Lassen material.

Mistletoe in Second Growth Western Yellow Pine.

The examinations last year of the mistletoe study plots established in 1920 on the Plumas and in 1926 on the Lassen indicated that the plots should again be revisited in 1931. These plots are furnishing valuable information on the development and spread of the yellow pine mistletoe. Publication of a portion of the material is planned as soon as the question of

delayed appearance of infection is settled.

Coryneum Canker of Cypress

This deserving project is one which suffered from the competition of emergency problems last season. Some additional scouting for the disease and the collection of trees for inoculation purposes were the main accomplishments during the past year. Thanks are due both to the State Forester for trees furnished from the Davis nursery and to the California Forest Experiment Station for stock from the Devil Canyon nursery to be used in susceptibility tests. Part of these trees were furnished last year but were found to be a little too small for the purpose and so have been held over. The inoculations are to be made during March. Due to the demand for information on the disease Wagener plans intensive work on the project this coming spring. Aside from a preliminary article in Science two years ago and some additional notes in the Monthly Bulletin of the State Department of Agriculture no publications on the disease have so far been issued.

Bluestain Prevention in Lumber

The project has been inactive during the year. The report on the pathological aspects of the Pinedale tests should be completed in 1931. An extensive series of tests on new compounds which might prove useful in bluestain prevention as well as commercial tests of the materials showing the most promise in preliminary trials have been undertaken by the New Orleans branch of our Office. As the results which they secure should be applicable in part to this Region no new tests are planned here for the present.

Bluestain in Insect-Attacked Yellow Pine

The report to the Regional Forester on the study made of stain and decay in insect-attacked trees on the Pickering Sale area of the Modoc was issued in April of last year. It confirmed previous observations by Colley and Person that bluestain appears very soon after attack by bark beetles. The initial staining does not often involve a large percentage of the sapwood and it is not until after secondary insects have become active that general staining occurs. Sapwood decay may show up within 4 months but does not become serious until later.

In response to complaints by the Crane Creek Lumber Company that lumber salvaged from heavily burned trees on the Sugar Hill area would be sure to develop additional stain in the drying yard, a test pile of lumber selected from logs of the type complained of was erected in July. On examination in September it was found that, in accordance with our expectation no extension of stain had occurred during seasoning. The test will provide a definite basis for refuting any future claims of the sort which may arise.

As an outgrowth of the stain observations on the Pickering Sale and of complaints made of brashness in lumber sawed from insect-killed trees the Office cooperated with the Bureau of Entomology and the Timber Sale force of the Modoc in obtaining and shipping to the Madison Laboratory for tests, 14 bolts cut from green and insect-attacked yellow pines. A brief report on the results of the test, issued not long ago by Mr. Newlin and Dr. Richards of the Laboratory, was to the effect that wood from insect-killed trees was found not to be any more brash than that from green trees and suggested that the breakage in the milling of lumber from the insect-killed trees was due to the prevalence of spiral grain and to checking.

We do not propose any work on the project in 1931 outside of a possible brief article for one of the coast trade journals on the highlights of the Modoc bluestain report.

Pathological History of Permanent Sample Plots

Eight M-C plots of the California Forest Experiment Station near Massack on the Plumas have been followed under this project, the first examination being made in 1919. The new note forms for the project were received last spring and the task of transferring all past notes to them has almost been completed by Mrs. Levendahl. The new forms should save considerable time in future field work. The tagging of snags and the expansion of field notes on deterioration of snags and down trees, which was tentatively programmed for last year has been carried forward to the coming season. The project will also be extended to include at least two of the Woods and Mill Study plots.

Effect of Defoliation on Conifers

The young yellow pines defoliated to different degrees on the California Forest were remeasured by Wright and Gill in September and a preliminary compilation of the measurements completed by Gill. A comparison of results showed that more experiments will be needed before definite conclusions can be drawn. Suggestions from the Committee as to the location of areas suitable for further experimentation will be welcomed.

Examination of Camp Grounds

The information previously gathered by Meinecke at Forest Service camp grounds and in the State parks in this Region on the effect on tree growth of concentrated occupancy by campers and tourists has been strengthened by his observations during the past year in some of the larger National Parks outside of the State.

During the coming year he expects to extend his examinations to additional Forest Service camp grounds and to other publicly owned camps and recreational areas.

Effect of Drought on Conifers

During the late winter and spring of last year widespread dying occurred in younger trees in many parts of the State. It was particularly noticeable in Douglas fir and incense cedar but other species, such as Monterey pine, redwood, madrone, white fir and western juniper were also affected. In Southern California many planted Eucalyptus trees died entirely and others were killed back. An examination of the Monterey pines dying on the Presidio of Monterey and the adjoining peninsula was made in March at the request of Colonel Fitch, the Commanding Officer at the Presidi The evidence seemed quite clear that drought during the preceding fall was the primary cause of the dying. A report on this and other pathological conditions on the Presidio grounds was made to Colonel Fitch.

In most of the other species mentioned the trouble was characteristically a die-back from the top which did not extend to the entire tree except in part of the incense cedars. Field and laboratory investigations by Meinecke, Wagener and Wright demonstrated that the die-back was almost entirely physiological rather than due to any insect or disease and, as in the Monterey pines, appeared to be connected with the drought of the preceding fall. Many inquiries from both public and private sources were received regarding the dying and it was the subject of several brief memoranda and reports.

Examinations are to be repeated this year on several of the areas where damage was severe last spring to see whether any extension of the dieback occurs and what recovery the top killed trees are showing.

Phomopsis disease of Douglas fir

In March 1930 dying of Douglas fir was reported to us from Lokoya, a resort area in Napa County. Preliminary investigation showed the cause to be a bark canker of fungus origin. Specimens forwarded to Dr. Hahn of our New Haven branch were tentatively identified as Phomopsis pseudotsugae, the cause of a serious disease of Douglas fir in the British Isles and elsewhere in Europe. Although the dying at Lokoya was localized, the character of the causal fungus gave it much more than local importance since Phomopsis pseudotsugae had not previously been reported from this country.

After further preliminary field examinations by Meinecke, Wagener and Wright, Dr. Boyce was detailed from Yale to make a thorough study of the situation. At the same time Dr. Hahn was running cultures to see if the fungus checked culturally with the European fungus.

Dr. Boyce's report has been completed but has not yet been receive here. Briefly he and Hahn found that the fungus is apparently not identical

with the European organism and is instead a native Phomopsis strain which occurs scatteringly through the North Coast Ranges into Oregon. Favorable climatic conditions seemed to have been responsible for the greater prevalence last spring.

Owing to its close relationship to the destructive European strain and the consequent interest which it has for pathologists observations on its comparative activity are to be continued for the next year or two by the members of this office.

Cytospora bark disease of fir

Mention has been made in previous reports to the Committee of this disease of fir on the eastern Tahoe. Last spring a rather marked extension of the damage from it occurred at the north end of Lake Tahoe and between there and Truckee as well as further north in the State. The threatened damage to valuable fir growth on summer home property as well as interest from the general forestry standpoint made it seem advisable to undertake an investigation of the disease. A start on this has been made by Wright who plans to continue it, to the extent that other project work will permit, during the coming year. The State Forester has cooperated in furnishing from the Davis nursery 34 balled young trees for use in inoculation tests to determine the pathogenicity of the fungus. Both field and laboratory work on the disease is planned for the coming season with particular emphasis on trying to determine the conditions favoring spread of infection.

Relation of Logging Injuries to Decay

This project was set up several years ago and in 1928 some time was spent in trying to locate areas suitable for the study. Nothing promising was located at that time and the project has been dormant since.

We know from our general studies of the relation of wounds to deca that wounding from any cause is undesirable and there is no reason for believing that logging wounds would form an exception to the rule. Moreover logging methods have changed somewhat in recent years and wounding is not th problem that it once was. The advice of the committee is desired on the que tion of whether the project should be continued and renewed efforts be made to locate suitable areas which would furnish information or whether it shoul be dropped.

Miscellaneous Activities

On the request of our Washington Office for material of the Pinyon rust, Cronartium occidentale, on currants or gooseberries several areas where the disease was formerly known to occur were scouted during the summer On one area the rust appeared to have died out entirely and on another only a trace could be found where it was formerly abundant. The disease is of

particular interest because the stages of Ribes are practically indistinguishable from the white pine blister rust. The causes for the disappearance of the rust in the locations scouted are not definitely known.

In response to a number of inquiries as to the cause for tree dying around Lake Tahoe trips of inspection were made by Wagener and by Wright and Gill. Wagener also accompanied Mr. Miller of the Bureau of Entomology on one trip around the Lake. A manuscript report on the pathological conditions found was issued by Wagener in October.

During the coming month a series of inoculation to determine whether Scotch pine (P. sylvestris) and red pine (P. resinosa) are susceptible to our coast pine gall rust, Peridermium cerebroides, are to be repeated by Wagener. The information is wanted in connection with the investigation being made of the Woodgate rust in the eastern states. Results of previous inoculations have been negative.

An examination of the dying of red fir along the Ebbets Pass road on the Stanislaus, partly in company with Mr. Miller of the Bureau of Entomology, showed that a lower levels a serious branch dying was caused by a combination of mistletoe, Cytospora and insects. At higher levels on the Mokelumne watershed the damage was found to be almost entirely of insect origin.

Inquiries regarding dry rot in buildings, wood pipe and other wooden structures have been fairly frequent during the year. The dry rot problem is undoubtedly gaining in importance in the State but no definite investigative work on it is planned for the present. A proper attack on the problem when undertaken, will require additional finances.

Action by Committee

Report approved. In connection with a statement by Dr. Meinecke that his studies of camp ground damage were leading to a conception of the necessity for rotation of campground use and the setting aside now of campground sites for future use only, the Committee urged the desirability of early publication of his results, for their helpfulness to forest supervisors and all foresters engaged in recreation administration.

Report on Blister Rust Control

Submitted by

W. V. Benedict - Office of Blister Rust Control

Intensive scouting for white pine blister rust in northern California during 1930 failed to disclose any evidence of infection. Scouting in southern Oregon, in the vicinity of Port Orford, where Ribes infections were found in 1929, was also negative. A new pine infection, consisting of 17 heavily infected western white pine trees, was discovered on the west slope of the Cascade Mountains in Linn County, Oregon. This is a southward extension of approximately 50 miles of known pine infection. Sugar pine occurs in this region but thus far no infected sugar pines have been found.

Experimental Ribes re-eradication studies on the Stanislaus National Forest showed an average cost of less than one-half of the initial eradication cost. Logging operations on the study area subsequent to the origina eradication stimulated Ribes establishment and resulted in a higher second eradication cost than would occur normally. A third eradication will be needed on parts of the area before permanent Ribes suppression is attained.

All of the important sugar pine areas of the Eldorado Forest, totaling 122,682 acres, were covered by control reconnaissance in 1930. It is planned to continue this work in 1931.

Studies in Ribes ecology have not as yet shown any correlation between Ribes occurrence in sugar pine types and any governable factor. Ecological data have, however, contributed information essential to the Ribes eradication program. This includes information on such factors as:

1. Annual rate of growth and establishment of Ribes in different types.

2. Age of earliest fruiting.

3. Time of completion of germination of possible seed stored in duff, following logging.

4. Factors governing distribution of Ribes.

Experiments and investigations designed to develop chemicals toxic to Ribes have been continued. Results to date have not been very successful so far as California Ribes species are concerned. Recent investigations indicate the possible value of stem injection methods of application for Ribes species difficult to kill by spraying. The use of oil sprays shows some promise on certain sites of heavy Ribes concentration.

Work in 1931 will be a continuation of all projects now under way. Experimental Ribes eradication will be conducted on one of the northern sugar pine forests, probably the Lassen. A thorough scouting program will be continued in northern California in search of the presence of the rust within the State.

Data from experimental Ribes eradication, control reconnaissance and Ribes ecology studies are becoming sufficient in number to make possible the development of a general plan of blister-rust control for the sugar pine belt. Such a plan is always urgently needed when the rust is first found in a region. It can not be made, however, until a comprehensive survey is completed giving in reasonably accurate form the location, age class and ownership of all pine areas under consideration for protection.

The Office of Blister-Rust Control is willing to cooperate in such a survey, but does not feel that it should take the entire burden. To what extent can Forest Service or other facilities, personnel and records be made available for such work?

Action by Committee

Report approved.

Report of U. S. Weather Bureau

Fire Weather Activities

Submitted by

L. G. Gray, U. S. Weather Bureau

All Weather Bureau projects have been discussed in detail at previous meetings. Briefly, these projects are:

1. Establishment of additional fire weather stations and operation of those already established, to the end that the climates of California as they relate to forest, grass, grain and brush fires may be satisfactorily determined for all parts of the State where such fires occur.

2. Operation of the mobile field forecasting station to provide localized forecasting service on going fires in the California Region in cooperation with the U. S. Forest Service and the California State Division of Forestry.

3. Designing of improved instruments for fire weather uses.

4. Fire weather studies intended to

   a. Outline features of California climates relating to forest, grass, grain and brush fires.

   b. Correlate meteorological elements with one another and with outdoor fires for information of value both in forecasting and to protection organizations.

   c. Improve fire weather forecasts.

1930 Progress and Proposed 1931 Activity

1. Fifteen new fire weather stations were established during 1930, most of them completely equipped, and principally at intermediate elevations in northern California. Instruments have been received from Washington and sent to various forests for installation early next season at ten more important points, including State stations. The total number of fire weather stations is now 91 compared with 76 a year ago. Some idea of the distribution of major stations can be obtained from the following list, showing stations equipped with anemometer (a) and hygrothermograph (ht):

Station	Forest	Equipment	
Mt. Gleason	Angeles	(a)	(ht)
Sheetiron Mtn.	California	(a)	(ht)
Alder Springs	California		(ht)
Cuyamaca Lookout	Cleveland	(a)	
Grizzly Peak	State	(a)	(ht)
Dry Lake Lookout	Klamath	(a)	(ht)
Orleans Mtn.	Klamath	(a)	
Happy Camp RS	Klamath		(ht)
Yreka	Klamath		(ht)
Susanville Nursery	Lassen	(a)	(ht)
Minarets Mine	Sierra (private)	(a)	(ht)
Happy Camp Lookout	Modoc	(a)	
Mt. Hough	Plumas	(a)	
Grass Valley Lookout	San Bernardino	(a)	
Frazier Mtn.	Santa Barbara	(a)	
Buck Rock	Sequoia	(a)	
Ash Mtn. H.Q.	Sequoia N.P.		(ht)
Shuteye Peak	Sierra	(a)	(ht)
Weaver Bally	Trinity	(a)	
Lower Trinity RS	Trinity		(ht)
Mad River RS	Trinity		(ht)
Yosemite	Yosemite N.P.		(ht)

During 1931, 7 anemometers and 10 hygrothermographs are available for issue. These go to the Shasta, Modoc, Plumas, Lassen and Tahoe Forests. The foregoing list does not include 5 anemometers and 2 hygrothermographs issued to the California Forest Experiment Station. Besides records from the Experiment Station instruments, 4 Forest Service hygrothermographs are in operation from which records may be secured. The total number of fire weather anemometers is 25, and hygrothermographs 24, exclusive of those not the property of the Weather Bureau.

2. The operation of the mobile field forecasting station was continued last year as the second of two experimental seasons. On the whole, its operation was satisfactory, and resulted in savings in suppression costs on going fires visited. A new agreement covering the continued operation of the mobile station for another two-year period has been entered into with the Forest Service and the California State Division of Forestry. The Station has demonstrated the entire practicability of receiving data for complete weather charts by radio under all field conditions, and the preparation of detailed charts in the field of the same grade as those prepared at

the district forecast center. Additional data, not available or used for district forecasts, are available and are incorporated in field forecasts issued by the mobile station.

The chief use of the services offered by the mobile station last season was on the Klamath forest during August. Service was also given to the State Division of Forestry in connection with proposed controlled burning operations in the vicinity of Ukiah and the North Coast section generally.

Two years' experience with the mobile station has served to crystalize methods, and it is hoped that this experience will result in further improvements in the service rendered by this station. It seems most satisfactory to perform station inspection work and issue demonstration forecasts during the early part of the fire season, but during the worst parts of the fire season, it seems more desirable to hold the mobile station on one forest or in one region for longer periods than heretofore, dispatching it elsewhere if the need develops. The fullest use of the mobile station, then, seems linked with limiting the station's activities to regions, the regions varying as the fire season develops, and in accordance with the needs of cooperating agencies in connection with special activities, like controlled burning.

3. During his detail at Washington, the fire weather official designed a psychrometer whirler for use in the small or cooperative observer's type of instrument shelter, which seems adapted to materially reduce breakage of psychrometers, to reduce the degree of skill required to take observations, to secure more uniform and satisfactory conditions of exposure, and to provide a more direct check on the indications of hygrothermographs and other recording or indicating instruments. The first model, now improved, however, by all-brass construction, with loose rotating handle and counterweight, is offered for demonstration and inspection by those interested.

The other instrument which has been designed and re-designed several times within the last two years, a light, relatively inexpensive, all-mechanical wind direction and velocity recorder, has finally reached the point where another working model for test will be constructed within the next year.

4. Three years of record are now available for a limited number of fire weather stations, and the computation of normals (more accurately speaking, averages) for these stations has been started with work on relative humidity.

The thunderstorm and lightning fire study, which has been under way for several years, is taking final shape. A number of difficulties

were encountered in making the available data fit what are considered to be the immediate needs for thunderstorm information. The study has been divided into four major parts, as follows:

a. Thunderstorm statistics.

b. Thunderstorm causes.

c. Thunderstorm forecasting.

d. Thunderstorm relationships (with other weather factors and with fires)

Nearly all of the data necessary have now been compiled, and the study is being written and graphs are being prepared, for publication in mimeographed form. Arrangements regarding publication of the study in whole or in part in printed form are in abeyance.

No further work is being done on other fire weather studies described in previous memoranda (wind, humidity, evaporation, precipitation, fogs, hazard rating scale) until the two studies listed above are completed.

No new projects are contemplated for 1931.

Action by Committee

The Committee approved the report and unanimously recommended that through the Forester the Weather Bureau be urged to assign sufficient office help for working up the mass of accumulated data bearing on the fire weather forecasting for California.

The Committee also approved Major Bowie's suggestion for early publication of the study of lightning fires by Gray, as a job of high priority.

DIVISION OF FORESTRY, UNIVERSITY OF CALIFORNIA

General

The general program of research work as carried out by the Division of Forestry of the University of California has been so often reviewed in these Investigative Committee meetings that the general plan and situation will be reviewed only very briefly as there have been no particular changes during the past year.

Objectives. At the present time in the Division of Forestry the main objective of research work is the development of the faculty and graduate students through personal research in the fields where greatest change is being made today. In order to properly develop first-class teachers of forestry it is felt by the administration of the University that research by the instructors in the most advanced fields of thought is essential. As President Sproul remarked in his first address to the student body, however, there are two phases to be considered in any research work. He said, "Is it true? And if it is what of it?" The research program of the Division of Forestry tries to live up to this standard and while it is developed along rather fundamental lines it endeavors never to lose sight of the essential usefulness of the possible results. It is not committed to a program of "pure" research as much as a number of other units of the College of Agriculture.

Organization. Each member of the faculty of the Division of Forestry has half the school year plus a part of the summer for carrying out research work. During the other semester he has relatively little time to devote to this type of work. The program of research work must be developed with this in mind.

Facilities. During the past year the Division has moved from its quarters in Hilgard Hall to new quarters in Giannini Hall. In this building we have better laboratory facilities than in the old one. There is a laboratory for plant ecology, equipped for biochemical work; a silvicultural laboratory, which is being equipped for histological and simple chemical research; a fire laboratory in which studies on the behavior of fuels can readily be made; and laboratories for logging, mensuration, and economics that are in the nature of computation and drafting rooms. A wood utilization laboratory is also furnished and is now equipped with woodworking machinery a good deal as it was in Hilgard Hall, although it now has somewhat more space for expansion.

We still have greenhouse space for carrying out experiments on plant ecology under controlled conditions.

Faculty Work of Past Year and Plans for Ensuing Year

Mulford. As in previous years there is no formal project work to be reported by Professor Mulford owing to the fact that his economic survey work is carried on as an activity of the California State Chamber of Commerce Progress has been made during the year in developing a series of carefully considered planks for a State Forest Policy but the time is not yet ripe for publication.

Schumacher. Professor Schumacher left the Division of Forestry last fall to take up new duties in the Washington office of the Forest Service. He is still working on the last project upon which he was engaged at the University, however. This study undertook to determine changes in form of western yellow pine that follow partial cutting of the stand. The work is now in manuscript form and early publication is expected. He found in general that a stimulated height and diameter occurred after partial cutting which had the effect of leaving the form of the tree very much as it was before. His work will be interesting in showing the development of stimulated height growth as this has usually been considered decidedly secondary in partially cut-over stands.

Schumacher's bulletins entitled "Yield, Stand and Volume Tables for Douglas fir in California", California Agricultural Experiment Station Bulletin No. 491, was published last summer.

No successor to Schumacher has yet been selected and even though an early selection is made it is improbable that the new man will be in a position to develop any research work during the next year. Research in forest mensuration will therefore be suspended.

Baker. During the past year a little preliminary work on the study of transpiration of coniferous seedlings was undertaken and several possible methods were worked out but no results of practical value were secured. Preliminary results indicate a strong movement of the stomata under the influence of light, and, like broadleafed plants, the rate of transpiration drops to a very low level at night. Given plenty of moisture seedlings only a few days old could not be made to wilt at temperatures exceeding 100° F., in full sun with a strong breeze from an electric fan blowing upon them, such delicate seedlings as redwood and western red cedar being used. It is hoped to have this line of work carried on by a graduate student during the present year, but final results will probably not be obtained.

Research work on this project has been suspended by Mr. Baker for the time being as he will undertake the preparation of a text book on silviculture with a western flavor to it.

Fritz. Last spring the logging study which Fritz had been carry-

ing on in the redwood region was compiled in a general way, but not prepared for publication. Since that time Mr. Fritz has become editor of the Journal of Forestry, the duties of which office take so much of his time that preparation of manuscript for publication has not been possible. No specific project work is contemplated for the next year by Fritz on account of the editorship duties.

Malmsten. Mr. Malmsten's research program for the past year has been cut to the barest essentials, as Malmsten has been in charge of moving from our old quarters in Hilgard Hall to the new ones in Giannini Hall, a process that has lasted from July to the present time, off and on, making the prosecution of sustained research work an impossibility for this year. At the end of Mr. Malmsten's teaching semester in May he expects to formulate a definite research program in forest protection, centering about problems of the chaparral zone. A program of laboratory studies will also be drawn up and correlated with the summer field studies, to use the facilities of the new fire laboratory to their fullest extent, and to make possible a program of year-round fire investigations.

Krueger. During the past year Mr. Krueger has been working on the phases of the logging and milling studies which were assigned to him. The progress of this work will be discussed under the main project on the Experiment Station's program. The essential parts of the logging study are now pretty well in hand, but will probably not be completed before summer. After the summer camp is over, and the fall semester begins, Krueger expects to develop some of the by-products of this investigation for publication some time next winter. No new line of investigation will, therefore, be undertaken during the current year.

Sampson. Closer cooperative work was entered into in 1930 than previously between the Farm Advisors of several northern counties of the State, and the Division of Forestry, with a view to determining the most suitable species for artificial reseeding of foothill and valley ranges. Many trials of suitable species were started. No further attempts are being made at this time to reseed lands where the seed bed has not been prepared. It has been pretty definitely demonstrated that artificial reseeding has practically no place on areas that have not been ploughed and harrowed. Some degree of success, however, is procured on a few non-plowed burned-over brush lands. In way of summarizing the results of the artificial reseeding tests a table of commonly used species has been prepared showing the soil, moisture, humidity, length of grazing season, etc. where successful results may be procured. This table is proving invaluable in replying to inquiries concerning reseeding.

Progress in natural revegetation has been chiefly in studying changes in nutrient constituents of native forage grasses, and of one browse species, namely, Gambel oak. Both in the grasses and the oak there is a striking decrease in certain important mineral constituents almost immediately following maturity. The leaching is greatly increased by rainy weather.

Also there is an appreciable change in the mineral constituents of some species as they approach maturity. The study emphasizes the wisdom of mowing and raking luxurious natural grass lands of the foothills prior to the coming of the dry summer season.

The study of carbohydrate metabolism of one perennial bunch grass, Stipa pulchra, and one annual grass, Bromus hordeaceus, has been published: Hilgardia, Volume V, No. 4, pp. 61-100, November, 1930. The most important point in the study is that grazing between the time of flower stalk production and seed maturity appears to prevent the accumulation of maximum carbohydrate foods, and tends to prevent maximum yields.

The study of root development in relation to frequency of grazing has been published under the title, "Influence of Leafage Removal on Anatomical Structure of Roots of Stipa pulchra and Bromus hordeaceus", Plant Physiology, Volume V, pp. 543-553, October 1930. A companion publication which reports the comparative weight of the top growth and of the root growth with a discussion of the physiology of such development, will appear soon as a Hilgardia.

The study of Hypericum perforatum in northern California has been reported in bulletin 503 of the College of Agriculture, (pp 48), December, 1930. Although this study has not been carried to a point where practical methods of eradicating the plant on a large scale is possible, certain valuable information has been brought out in the use of sprays suited for the destruction of small infestations.

In October, 1930, the manuscript, "Management of California Range Lands", was submitted for publication. The paper is now in press and will appear as a bulletin of the College of Agriculture. Although there are many points discussed in this paper it requires much more investigation, the consideration of the broader phases should prove helpful.

The study of soil horizons has been published as a Hilgardia under the title, "Establishment and Succession of Vegetation on Different Soil Horizons", Volume V, No. 7, (pp. 155-174), November, 1930. The much more vigorous growth of annual and perennial species on horizon "A" is apparently caused by more favorable soil texture, a larger amount of nitrate nitrogen, and of certain important mineral constituents. The importance of maintaining under all conditions a well developed "A" horizon can not be over-emphasized.

In view of the need for further information as to the relative water utilization of different plant types, work has been started modestly along this line. A trench five feet deep and sixty feet long has been established on the Oxford Tract. Phytometers that will hold one thousand pounds of soil have been constructed for use in the trench. A portable derrick, which can be moved on a track over the trench, is provided with Fairbanks scales which are reported to weigh accurately to within one-half

pound. Certain grasses are being grown on some of the phytometers merely to develop a suitable technique. During the year two papers were read before engineers and water users, relative to soil and water conservation. The paper, "Erosion in its Relation to Soil Productivity", will be published in Agricultural Engineering. The paper, "Yield and Water Utilization of Vegetation Grown on Different Soil Horizons", appeared in mimeographed form with other papers on the subject, as a publication by the American Society of Engineers.

Studies in Range Management in 1931 will be confined chiefly to work in the chaparral type, particularly burned-over areas. The work on mineral constituents of grasses now under investigation, and of oak brush, will be continued. In forest influences progress will be made in the study of water relations of a few species.

Graduate Students

There are at present 23 graduate students registered in the Division of Forestry. Most of these men have not proceeded far enough to have a definite study outlined for their thesis. Five of them, however, have this work well under way, as follows:

Nicholas T. Mirov. "Methods of Oleoresin Distillation of California Pines". This is a study which Mirov has handled personally in the field, and with which most of the Investigative Committee are already familiar.

Teh-i Li. "Seasonal Distribution of Soil Moisture in Woodland, Brush and Grassland Associations of the Central Region of California". This is an important study, rather simple, and obvious from a certain point of view, but one that has never been adequately carried out, owing to the enormous bulk of work that is required and the careful painstaking technique Mr. Li is gathering soil samples at regular intervals (also at irregular intervals immediately after rains) at different depths in woodland, brush and grassland in the Berkeley hills. The moisture content of the soil will be expressed as available moisture, rather than total moisture, which is in itself a departure in studies of this kind. He will be able to trace the increase of soil moisture under different classes of cover in the rainy season, and the progressive drying of the soils as the dry season comes on.

John R. Freeman. "The Properties and Uses of Sugar Pine". The scope of Freeman's work, which is being done under Fritz, is well expressed in the title of his study.

W. G. Morris. "Effect of High Temperature and Moisture Content on Viability of Seed of Douglas Fir and Yellow Pine". Before Morris undertook graduate work here he had become interested in the possibility that Douglas fir seed in particular was injured by too high temperatures in the kilns while the cones were wet. The effect of temperature on viability has been roughly worked out a number of times, but never has temperature and moisture been carefully correlated. The work is well under way and promises interesting results.

J. G. Osborne. "Factors Affecting the Substitution of Other Materials for Wood". This is an economic study the scope of which is well illustrated by the title. The work is being carefully done and his thesis promises to be very interesting.

Action by Committee

Report approved.

Report of the Eddy Tree Breeding Station.

Submitted by

Lloyd Austin, Director

General

The plan of work of the organization since its inception in 1925 has been to try out, as early as possible, all distinct methods of attacking the general problem, so the preliminary results along different lines can be used as a guide in determining which methods are worthy of intensive study in the future. The virgin character of the field in which the Station is working, together with the long-time nature of the enterprise, makes such a comprehensive survey and trial of methods the logical first step.

A point is now being reached where the field and nursery work in connection with the first trial of the various lines of attack is nearing completion, but there is a vast amount of accumulated data in need of being worked up and interpreted. It is therefore planned to greatly restrict all nursery and field activities for a year or two, until all material has been put in good shape. In the meantime the 4,577 experimental trees that have been planted out at the Station and the 1,453 that have been planted in the field planting to date, will be developing and yielding data each year that will throw further light upon the best ways of bringing about quick results in forest genetics.

As the Station has been working along so many different lines, it would make too lengthy a report at this time to cover them all adequately. Instead, therefore, of just touching on each one lightly, this report will be confined mostly to two of the important experiments, namely the Pollination Experiment and the Progeny Test Experiment.

Pollination Experiment

A. P. attenuata x P. radiata Hybrids

The work in cross pollinating different species of pines has yielded 26 seedlings of a hybrid between Pinus attenuata (Knobcone pine) and Pinus radiata (Monterey pine). These hybrids are distinctly intermediate in their various characteristics, but most of them resemble the pollen parent, Pinus radiata, more than they do the seed parent, P. attenuata.

The size of the majority of the hybrid seedlings almost equals that of the nearby large Monterey pine seedlings of the same age. They are much larger than the normal Knobcone seedlings from exactly the same mother

tree. Quite a number of the hybrid seedlings have another character which clearly indicates their hybrid nature. The Knobcone seedlings characteristically form hard well-matured terminal buds, while the Monterey seedlings almost always have the immature terminal cluster of primary needles, which we term a "paint brush" terminal. It is interesting to note that about half of the hybrids have this "paint brush" terminal, and the rest have either the hard bud, or one of intermediate type. These hybrids show definitely that distinct pine species can be artificially hybridized and they are, therefore, a very encouraging development.

B. P. Ponderosa x P. Ponderosa Scopulorum Hybrids

We also have 271 seedlings representing the cross of P. ponderosa x P. ponderosa scopulorum, the Rocky Mt. variety of western yellow pine. Many of these seedlings resemble the pollen parent in the gray or yellowish color of the foliage, and in their leaning habit. Fifty-five per cent of the P. ponderosa flowers that were pollinated with pollen of its variety scopulorum set good cones which yielded seed. This set was just about the same as that secured when P. ponderosa flowers were pollinated with pollen from other P. ponderosa trees, and was much higher than when the trees were self-pollinated. Only 37% of the 902 flowers that were pollinated with pollen from the same tree matured into cones. This indicates that western yellow pine is partially self-sterile, and produces seed better when the pollen comes from neighboring trees, than when it comes from the same tree.

C. Improved Pollination Equipment and Technique

At this meeting last year mention was made of the need for developing improved bags and methods of pollination for pines, in order to be able to increase the certainty of the parentage of the hand pollinated seeds, by avoiding the possibilities of occasional contamination by wind-blown pollen.

Reasons for the Need of Special Technique and Equipment

The difficulties in keeping foreign pollen out of the bags are brought about by several very unfavorable factors, with which most plant breeders do not have to deal.

In the first place, the pollen is borne very much more abundantly than is the case with most of the crop plants. It is a fairly common sight to one who has been in the forest when the pines are in bloom, to see the surface of a nearby lake literally covered with the yellow pollen from the trees. Its abundance is also testified by the shipment of about a quart and a half of pollen of Pinus longifolia which was received last year from India.

The second feature which enhances the chance of contamination is that each pollen grain is equipped with two air sacks, which make it buoyant and able to float around on the slightest breeze.

These factors, combined with the fact that the flowers are usually borne high up in exposed, windy situations in the trees, cause the utmost difficulty in devising a truly effective method of artificially pollinating pines. The bags must be capable of withstanding the storms for a period of 4 to 6 weeks.

New Bags and Pollinating Methods

Suggestions were made at this meeting last year that cellophane be tried as a material for the bags. Bags made of a heavy grade of this material stood up fairly well from the time they were put on over the flower buds, up until the time of pollinating the ovulate flowers. But soon after that the growth of the needles around the flowers punctured numerous holes in the cellophane, particularly at the edges.

However, the idea of using something transparent has been incorporated in some of our present bags, which are made of tightly-woven pollen-proof army duck, and which contain windows of various types. Two of these are shown in the samples presented for examination. No trouble has been experienced with the needles projecting through these windows. We have not been able to secure Cellophane in a heavier grade than 12/1000 of an inch, but have obtained heavier material of a similar nature sold under other trade names particularly Pyralin and Kodaloid, which comes as thick as 15/1000 inch. These have proved fairly satisfactory for windows, but there have been some indications of the material becoming brittle after exposure to the sun, and it is not known as yet whether or not the same window will serve more than one season, or if it will have to be replaced.

A recent development is the trial of unbreakable clock glasses called G. G. Flexo, which are glued in place with waterproof glue, and then varnished. These have promise of being quite satisfactory, but are rather expensive, when several thousand are needed in a given season's pollination work.

The purpose of the window is partly to let light in and perhaps bring about more normal development, but its main object is to enable one to watch the ovulate flowers and determine when they are ready to pollinate. Present standard practice calls for pollinating all pine flowers without removing the bag, since there is too much danger of wind contamination when the bag is taken off. Three distinct methods have been devised for accomplishing this.

The most nearly perfect system consists in placing a corked vial of the desired kind of pollen in the bag at the time when it is placed over

the ovulate flower buds. A couple of weeks later, when an inspection of the flowers through the window reveals that they are in the receptive stage, the vial and cork are grasped through the canvas part of the bag, the cork removed, and the pollen dusted over the open flowers. In this way the artificial pollination is accomplished without the slightest possibility of foreign pollen reaching the flowers.

This method, however, has one drawback which sometimes limits its use, and that is that the desired kind of pollen must be ripe and available for use at the time when the bags are placed over the flower buds. Other methods must be used when one wishes to use pollen of late-blooming pines, or pollen that arrives the last minute from some foreign country. Two methods of pollinating, without removing the bag, have been worked out to take care of such conditions.

The first method, which is especially serviceable when pollen is scarce, is what is termed the "protected-brush" method. When the ordinary time-honored camel's hair brush was used for applying the pollen, it frequently happened that the wind made away with most of the pollen while the brush was enroute from the vial to the flower. This caused much waste of pollen, and there was also still another danger, that is, the chance of wind-blown pollen entering the vial while the cork was removed to get at the pollen.

Both of these difficulties have been overcome by the use of a brush that is drawn inside a brass tube, and then inserted into the vial of pollen through a rubber nursing bottle cap having a small slit made with a pen knife. As the protected pollen-laden brush is withdrawn, the rubber immediately closes up the opening, thus foiling Mother Nature in her continual efforts to get some wind-blown pollen mixed with the pollen of the kind being used for the artificial crossing. The brush-containing tube is inserted into the bag through a small slit at the end, and after pollinating the flowers and withdrawing the tube, the slit is effectively closed by means of a special metal clip (which, incidentally, is in need of some improvement).

The second method consists in using, in a controlled and directed way, Nature's own means of distributing pine pollen, namely the use of air currents. The pollen is contained in a rubber blower having a long brass tube, protected with a thin flexible cloth covering, which is drawn back as the clean tube is injected into the bag through the slit, to pollinate the flowers. This method requires plenty of pollen, but quite frequently there is sufficient to allow its use. The blower may make it possible to dispense with the window in some cases, as it probably is not necessary to direct the stream of pollen at the flowers. It would very likely be sufficient to simply shoot the pollen into the bag, after determining the approximate degree of maturity of the flowers in the bag by an examination of the unbagged ones

nearby. Observations have indicated that the bags have little influence upon the time when the flowers reach the receptive stage.

There is just one more refinement that might be mentioned, which illustrates the complete way in which undesired pollen is being kept out of the bags. It has been thought that pollen might sometimes enter the bag at the place where it is tied to the limb, particularly when the limb is rough or is covered with needles. To obviate this difficulty the needles are removed and a strip of cotton batting is wound around the limb, before tying on the bag. Cotton is used by bacteriologists to keep test tubes free from bacteria, and it would seem that it should be effective in keeping pollen from gaining entrance to the bags in this way.

Progeny Test Experiment

A. Purpose and Nature of the Test

While this is mainly a nursery experiment, its object is to locate inherently vigorous seed-bearing trees in the forest, by testing the progenies of many trees simultaneously, under relatively uniform nursery conditions. The experiment was planned to demonstrate the existence of the numerous inherently distinct geographical races of Pinus ponderosa - and also to show whether or not there are genetic differences in the make-up of individual forest trees growing side by side in the same stand. It was felt that, to be worth while, selection work of this sort would have to be conducted with a comparatively large number of mother trees distributed over a wide range.

B. Magnitude of the Experiment

In order to convey some idea of the size of this experiment a table is presented giving a few facts and figures about it.

Source of Seed		Nursery Data	
States	12	Nursery Plots	3,110
Counties	60	Measurements	73,505
Field Plots	126	Averages	16,515
Mother Trees	765	Points Plotted	17,360

1. Source of Seed

a. States. Seed of P. ponderosa and its varieties was obtained from almost its entire range, and came from British

Columbia and the following 12 states: Washington, Oregon, California, Idaho, Montana, South Dakota, Wyoming, Nebraska, Colorado, Utah, Nevada, and Arizona.

b. Counties and Field Plots. It will be seen that the seed was collected from 126 different field plots scattered through 60 counties, which gives an average of a little over two field plots per county.

c. Mother Trees. This entire experiment is based upon seed collected from 765 known mother trees, each of which bears a permanent aluminum tag for future identification purposes. Field notes are on file at the Station giving directions for reaching each tree.

2. Nursery Data.

a. Nursery Plots. As this test has to do principally with the vigor of the seedlings, which fluctuates with the slightest change in nursery conditions, it has been found that the only safe way to judge the inherent vigor of each progeny is to base the study upon its average behavior in 4 different plantings in vairous parts of the nursery. This greatly increases the complications of the test, and has necessitated the use of no less than 9,110 labeled nursery plots.

b. Measurements. In the past only height and diameter data have been taken on most of the experiments, but this past winter a measurement of the branching was also taken in the 2-0 Progeny Test Experiment. This made three measurements at the age of 2 years and two at the age of one, on every seedling, or a grand total of 73,565 measurements in this one experiment.

c. Averaging and Plotting. The one-year data have not yet been worked up, but that for the 2-year old trees are now in fairly good shape. To date 16,515 different averages have been figured and 17,350 points have been plotted on cross section paper in the preliminary analyzing of the results.

C. Interpretation of the Data

1. Method of Correcting the Figures for Spacing.

While every effort has been made to maintain a regular unifor spacing of the seedlings in the nursery, some irregularities are bound to

occur, due to the occasional inroads of such troubles as damping off and cut worms. It has therefore been found desirable to determine the seedbed density for each progeny. Where the spacing is more open than the standard, a correction factor has been applied, based upon the average results of two different experiments in spacing or seedbed density.

It was found that within the limited range in densities occurring in the Progeny Test Experiment (namely from about 4 to 9 trees per square foot), little or no correction was needed for the height data, but the data for diameters and branching required quite a little correction in the case of the few progenies growing at rather open spacings. That is, the extra growing room made some of the trees stockier and more branchy, but such of this as was directly attributable to the reduced competition (as determined for each density by the Spacing Experiments) was subtracted from the original data, leaving, as nearly as can be determined, only the hereditary differences.

2. Percentage Method of Expressing the Data.

In order to be able to properly average and compare height, diameter and branching figures, all the data have been converted into a unit that is comparable, namely percentage. The average of 50 well-distributed Standard Seed plots has been taken as 100%, and the progeny data are expressed in per cent of this. For example, a progeny that averages just half as high as did all the Standard Seed plots would rate 50% on heights. The Standard Seed itself is a mixed lot of seed from El Dorado County. The following averages of Standard Seed Plots were taken as 100%:

Heights	-	.94 foot
Diameters	-	.32 inch
Branching	-	.9 foot

D. Preliminary Results

1. Variation in Average Vigor of Different Field Plots in the Same County

Attention is here directed to Chart No. 1, which shows graphically (in the upper half) the height, diameter and branching of an average progeny from three El Dorado County field plots. In studying these charts it will be found helpful to concentrate one's attention at one time on the three lines of one color. For example, by comparing the lengths of the different red lines, it will be seen that the average heights of the seedlings from different plots throughout the country ranged all the way from a weak field plot averaging 72% up to a vigorous one averaging 115%. This indicates clearly that what has sometimes been termed the "fine Eldorado strain" of western yellow pine is by no means a distinct entity, but is composed of a

conglomerate assortment of local strains, each having different genetic tendencies.

It might at first be thought that a measurement of the height would give a fair indication of what the diameter or branching would be, but it is very apparent from the chart that there is comparatively little correlation. That is, each local strain within the county has its own form factor, and its own tendencies for branching.

The lower part of Chart No. 1 shows that a somewhat similar condition exists in Lassen County, except that there the normal plot averages considerably lower than the weak one for El Dorado County. Lassen Plot 3 is fairly typical of all the material tested from this county. No outstandingly weak plot was found there, but Plot No. 1 was found to be exceptionally vigorous for that region.

2. Variation in Vigor of Different Progenies from the Same Field Plot

Not only are there marked differences between the average vigor of the progenies from different field plots in the same county, but there are also very pronounced differences between different progenies from the same field plot. This is brought out clearly in Chart No. 2, the upper half of which shows the data for three different progenies from Mariposa County field plot No. 1. This is getting down to the individual tree differences, the detection of which was the main object of the experiment. It is apparent at once that tree No. 3 in this plot produces very superior seedlings, which run quite uniformly large in height, diameter and branching. It is most interesting to note that, by a mere coincidence, the weak, normal and vigorous trees of this plot happened to be numbered 1, 2 and 3 indicating that they are growing side by side in the field, yet their inherent differences are so great as to be almost unbelievable. It is entirely possible that these differences may become even more pronounced as the trees become older.

It has been a revelation to us to find that such marked differences in vigor could be shown in an experiment of this type where only one parent is known and controlled. It would seem to indicate that the mother trees themselves are probably even farther apart in their hereditary nature than their progeny indicates, as some of the difference is undoubtedly obscured by the pollination of their flowers with pollen from various nearby trees of different vigor.

The lower half of Chart No. 2 shows the data for a vigorous, normal and weak progeny from El Dorado county field plot No. 3. The seedlings of the vigorous progeny are even taller than those of the vigorous Mariposa progeny, but their diameter is somewhat less, indicating a differ-

ent height-diameter ratio. The progeny listed as "normal" is normal only in height and diameter, as its branching is equal to that of the vigorous one. The weak one is consistently low in all three respects.

3. Variation in the Branching of Different Progenies from the Same Field Plot

That these differences are not confined to the general size of the seedlings, but that they also have to do with striking variations in the extent of branching, may be seen from Chart No. 3. The upper half shows the variation between 3 progenies from El Dorado county field plot No. 21. There is comparatively little difference in the heights and diameters of these three progenies, yet the branching of the weak one is only 50%, and of the vigorous one 15%, or a range of just 100%.

A somewhat similar difference is to be found between the progenies from Yuba County field plot No. 3.

It has been thought by some that the differences in the number and size of the branches to be noticed on different trees in the forest were due solely to variations in the environment of the trees, especially the spacing of the stand; that is, abundant growing space caused a limby development, and dense crowding resulted in clean boles. While it is quite true that the density of the stand does have the influences noted, it seems fairly certain from the tests so far that there are also present in certain trees strong hereditary tendencies for producing clean boles that would yield a superior quality of lumber.

Unfortunately, however, the matter of the amount of branching on the seedlings is by no means a simple problem, and some discussion along this line would be appreciated. The difficulty arises from the fact that the fewer the branches the better, as far as well-formed trees are concerned, but seemingly the reverse is true from the point of view of inherent vigor.

We have considered oven-dry weights as being the best measure of vigor, but have been unable to apply this to the Progeny Test Experiment on account of its magnitude. But it would seem very probable that the progenies that would come out ahead on an oven-dry weight basis, would be about the same ones that would lead if the selection were made of those highest in height, diameter and branching. If two progenies were equal in height and diameter, the one with the greatest branching would be the most vigorous, and might make the most growth in later years.

The only solution that we have so far to this difficulty is to select both the branchy and the clean-stemmed types for planting out, and keep records on their relative future growth. Any suggestions along this line that the Committee might care to make will be welcomed.

E. Subsequent Tests of the Same Mother Trees

The future tests that are planned to check the differences so far found are of two types.

1. Plantation tests

The first step is to be the inclusion of 110 of these progenies in experimental plantations at the Station and in the field. Fifteen different bases were used in selecting the progenies for these plantations. Among other things, progenies are being included to represent every one of the 60 counties from which the seed originated.

2. Nursery tests

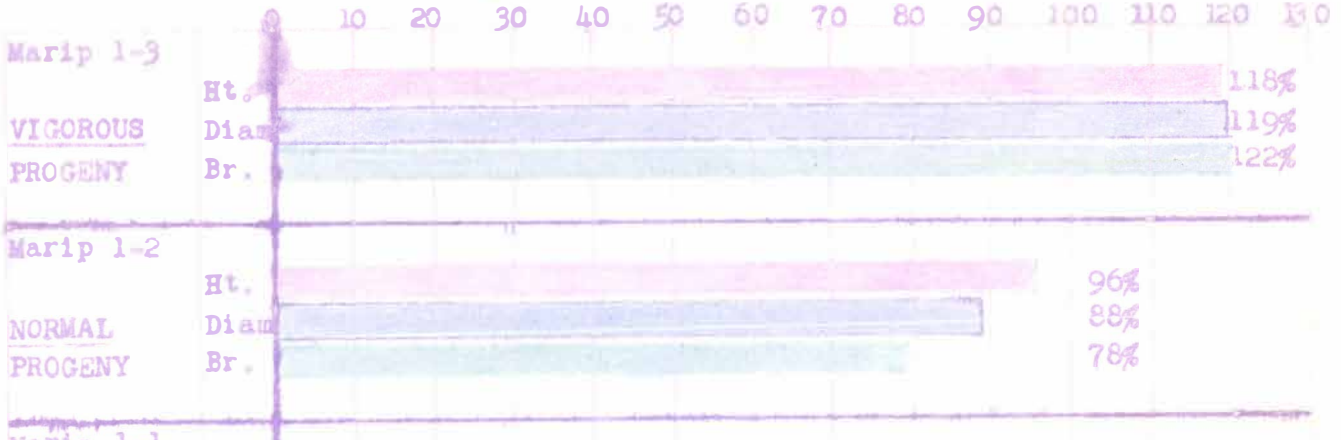
The second step will be to make further nursery tests of all of the best progenies to check the results already obtained. Sufficient left-over seed is available of nearly all the progenies for another nursery test, but before the results can be considered final, more seed should be collected from all the more promising mother trees. While much has been accomplished there seems to remain plenty yet to do.

VARIATION IN VIGOR OF DIFFERENT PROGENIES FROM THE SAME FIELD PLOT CHART NO. 2
(EDDY TREE BREEDING STATION - 1929 NURSERY SECTION OF P. PONDEROSA)

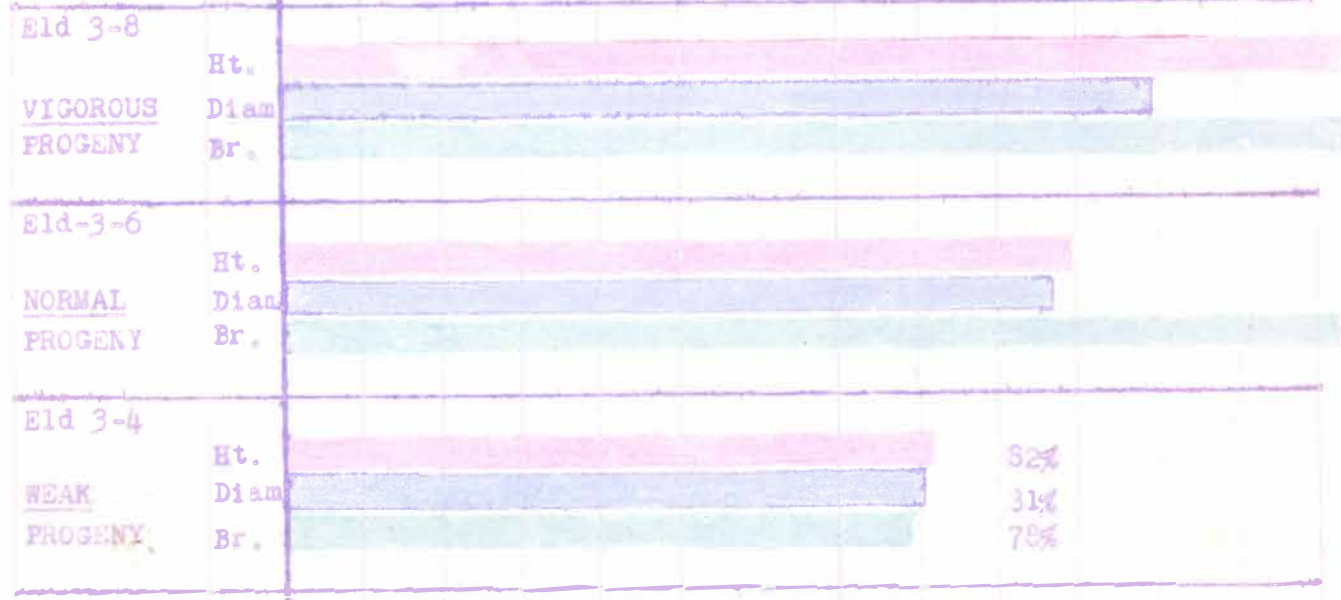
Based on the average measurements of about 25 to 40 2-0 seedlings of each proge
distributed thru 4 nursery plantings.
The average of 50 well-distributed Standard Seed plots is taken as 100%, and the
progeny data are expressed in per cent of this.

= HEIGHTS = DIAMETERS = BRANCHING

3 Progenies in Mariposa County Field Plot No. 1



3 Progenies in Eldorado County Field Plot No. 3



GRAPH NO. 3

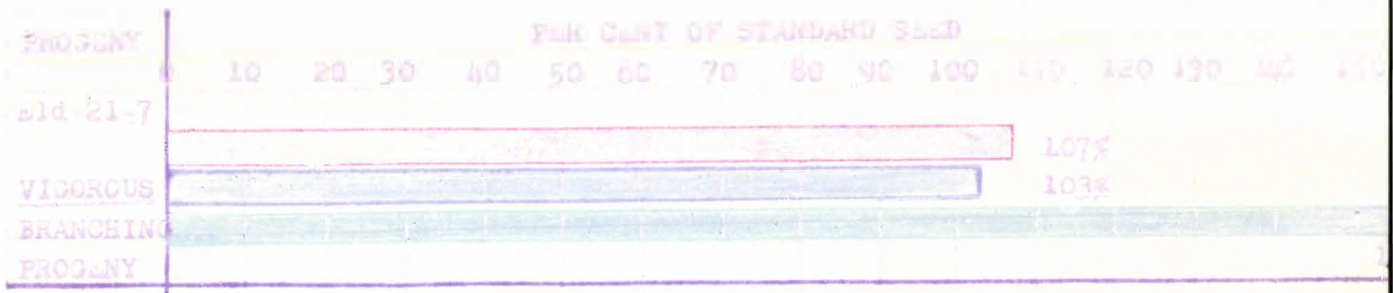
VARIATION IN THE BRANCHING OF DIFFERENT PROGENIES FROM THE SAME FIELD PLOT
(LEDDY TREE BREEDING STATION - 1949 NURSERY SECTION OF P. PONDEROSA)

Based on the average measurements of about 25 to 40 2-0 seedlings of each progeny, distributed thru 4 nursery plantings.

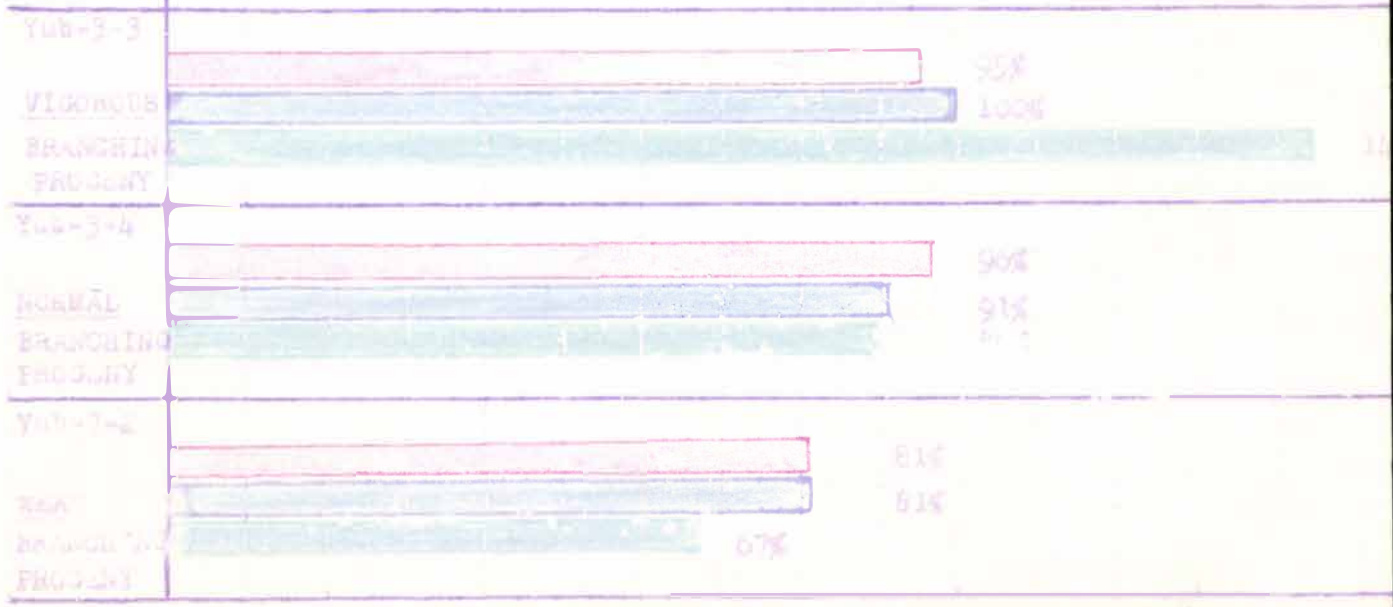
The average of 50 well-distributed standard seed plots is taken as 100%, and the progeny data are expressed in per cent of this.

[ ] = HEIGHT [ ] = DIAMETER [ ] = BRANCHING

3 Progenies In El Dorado County Field Plot No. 21



3 Progenies In Yuba County Field Plot No. 3.



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ADDRESS REPLY TO
DIRECTOR
AND REFER TO

UNIVERSITY OF CALIFORNIA,
332 GIANNINI HALL,
BERKELEY, CALIFORNIA

R - CAL
Investigative Program

September 21, 1931

Dear Sir:

In sending out the annual investigative report for this Region for 1930-1931, there were unfortunately omitted charts pertaining to the report of the Eddy Tree Breeding Station, Placerville, California, and frequently referred to in their report. A copy of these charts is enclosed herewith, which should be inserted in the main report as sent to you, following page 245.

On account of the limited number of these charts available, it is suggested to institutions having more than one copy of the Regional report, that notation be made at the foot of page 245 in other copies, to the presence of the charts in the copy with which you include them.

Very truly yours

C. L. HILL, Secretary
Regional Investigative Committee

Enclosure